THE LIBRARY OF CONGRESS
PERIODICAL RECORD
AUG - 4 1948

VOL. 25, No. 7 JULY, 1948

AMERICAN JOURNAL OF OPTOMETRY *and* ARCHIVES *of* AMERICAN ACADEMY OF OPTOMETRY

EDITORIAL COUNCIL

J. FRED ANDREAE, *Baltimore, Md.*
I. M. BORISH, *Kokomo, Ind.*
M. N. CHODROFF, *Brooklyn, N. Y.*
H. M. FISHER, *Mt. Kisco, N. Y.*
GLENN A. FRY, *Columbus, Ohio*
H. W. HOFSTETTER, *Columbus, Ohio*
D. G. HUMMEL, *Cleveland, Ohio*
E. A. HUTCHINSON, *Los Angeles, Calif.*
E. J. MARGARETTEN, *New York, N. Y.*
M. W. MORGAN, JR., *Berkeley, Calif.*
J. NEUMUELLER, *Haddonfield, N. J.*
C. A. RADDE, *Cleveland, Ohio*
H. SIMMERMAN, *Woodbury, N. J.*
C. L. TRELEAVEN, *New York, N. Y.*
A. P. WHEELOCK, *Des Moines, Iowa*

STAFF

CAREL C. KOCH, *Editor*, *Minneapolis, Minnesota*
ROBERT E. BANNON, *Research Editor*, *Hanover, New Hampshire*

COLLABORATORS

M. ALPERN, *Columbus, Ohio*
S. H. BARTLEY, *Lansing, Mich.*
E. BATEMAN, *Looe, Cornwall, Eng.*
R. C. BAXTER, *Warren, Ohio*
N. BIER, *London, Eng.*
A. G. BILLMEIER, *Denton, Md.*
E. E. BRANN, *Independence, Kans.*
C. S. BRIDGMEN, *Pt. Washington, N. Y.*
L. G. CHASE, *Springfield, Vt.*
J. B. CONLOGUE, *Peoria, Ill.*
J. C. COPELAND, *Chicago, Ill.*
G. L. COPPOLA, *Philadelphia, Pa.*
J. R. DEAN, *Los Angeles, Calif.*
W. E. DEWEY, *Battle Creek, Mich.*
I. DVORINE, *Baltimore, Md.*
M. T. EBERL, *Milwaukee, Wis.*
R. EHRENBERG, *Granite Falls, Minn.*
V. J. ELLERBROCK, *Columbus, Ohio*
A. B. EMMES, *Berkeley, Calif.*
H. W. EWALT, JR., *Pittsburgh, Pa.*
R. FEINBERG, *Lafayette, Ind.*
W. FEINBLOOM, *New York, N. Y.*
I. P. FILDERMAN, *Memphis, Tenn.*
L. P. FOLSOM, *South Royalton, Vt.*
E. FREEMAN, *Chicago, Ill.*
H. L. FUOG, *Los Angeles, Calif.*
R. C. GRAHAM, *Pasadena, Calif.*
R. M. HALL, *Cleveland, Ohio*
S. S. HANIFORD, *Buffalo, N. Y.*
E. L. HIGGINS, *Cleveland, Ohio*
J. M. HIRSCH, *Stanford Univ., Calif.*
A. E. HOARE, *Los Angeles, Calif.*
E. E. HOTALING, *New York, N. Y.*
F. W. JOBE, *Rochester, N. Y.*
O. H. JOHNSON, *Jonesboro, Ark.*
R. S. JORDAN, *Cleveland, Ohio*
C. A. KAUFFMAN, *Suffolk, Va.*
G. W. KEEVIL, *Toronto, Ont.*
A. S. KITCHEN, *Clearwater, Fla.*
L. H. KRASKIN, *Washington, D. C.*
J. D. KRATZ, *Souderton, Pa.*
G. A. MACELREE, *Philadelphia, Pa.*
O. L. MCCULLOCH, *Holyoke, Mass.*
L. F. MADIGAN, *Boston, Mass.*
R. MARKS, *Dayton, Ohio*
J. W. MOGEY, *Flushing, N. Y.*
C. W. MORRIS, *Fort Wayne, Ind.*
H. I. MOSKOWITZ, *Wilmington, Dela.*
H. G. MOTE, *Columbus, Ohio*
J. C. NEILL, *Philadelphia, Pa.*
J. S. NUPUF, *Canton, Ohio*
D. R. PAINE, *Topeka, Kan.*
G. A. PARKINS, *Ord, Nebr.*
J. I. PASCAL, *New York, N. Y.*
J. D. PERRY, JR., *Winston-Salem, N. C.*
H. E. PINE, *Chicago, Ill.*
D. F. PREBLE, *Bath, Maine*
E. E. REESE, *Westerville, Ohio*
R. J. ROTH, *Southbridge, Mass.*
A. J. ROWE, *Cleveland, Ohio*
E. LEROY RYER, *New York, N. Y.*
W. P. SCHUMANN, *Vineland, N. J.*
C. SHEARD, *Rochester, Minn.*
J. R. SHREVE, *Indianapolis, Ind.*
F. W. SINN, *Philadelphia, Pa.*
D. A. SPRINGER, *Anniston, Ala.*
K. B. STODDARD, *Berkeley, Calif.*
R. T. TEXTOR, *Cranford, N. J.*
D. C. THOMSON, *Detroit, Mich.*
R. W. TUBESING, *Richmond, Ind.*
W. L. VAN OSDOL, *Indianapolis, Ind.*
G. L. WALLS, *Berkeley, Calif.*
R. WALSH, *Chicago, Ill.*
W. G. WALTON, *Merion, Pa.*
G. H. WARKENTINE, *Cedar Rapids, Iowa*
J. J. WEY, *Painesville, Ohio*
R. E. WICK, *Rapid City, S. Dak.*
E. G. WISEMAN, *Buffalo, N. Y.*
D. WOOLF, *New York, N. Y.*

Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION,
1502 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

ANNUAL SUBSCRIPTION $5.00 CANADA $5.50, FOREIGN $6.00
Single copies, 50c

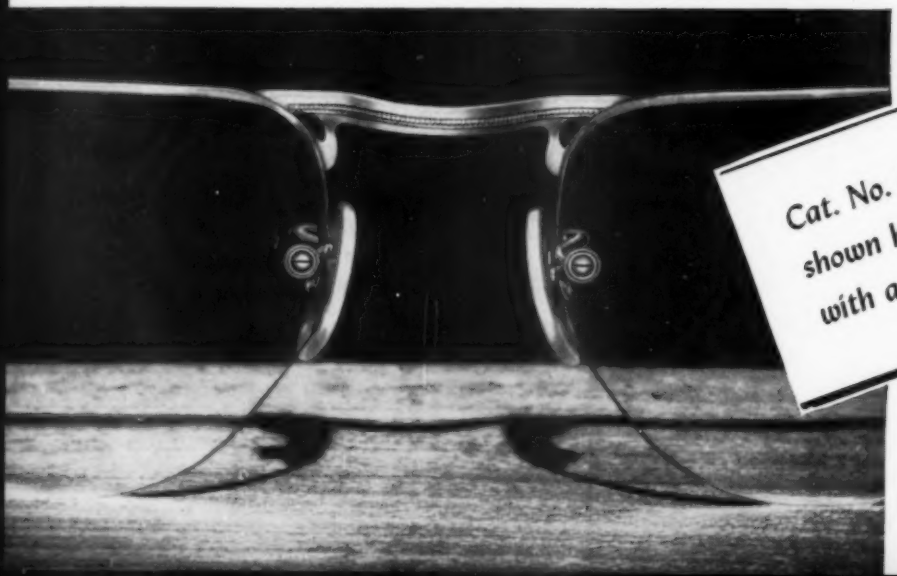
Entered as second-class matter, February 20, 1924, at the post office at Minneapolis 2, Minnesota, under the Act of March 3, 1879
Established 1924

Take a Look at the NEW LYNN

You'll Like This New Tailored Type Cushion-Mount Designed in Simple Good Taste

The bridge gives the appearance of a straight horizontal line, but is curved to fit the nose.

Just the right touch of engraving is added by a raised beaded panel. There's lots of gold stock to give strength, rigidity and wear.



Cat. No. 6295-66 Lens shape shown here, Pattern No. 1158 with a seven difference.

Continenta

INDIANAPOLI

AMERICAN ACADEMY OF OPTOMETRY

Dr. Harold M. Fisher, *President*
Mt. Kisco, New York

Dr. D. G. Hummel, *Vice-President*
Cleveland, Ohio

Dr. Carel C. Koch, *Secretary*
Minneapolis, Minn.

EXECUTIVE COUNCIL

Dr. Harold M. Fisher, *Chairman*
Mt. Kisco, N. Y.

Dr. D. G. Hummel, *Vice-Chairman*
Cleveland, Ohio

Dr. Carel C. Koch, *Secretary*
Minneapolis, Minn.

Dr. J. Fred Andreae, *Past President*
Baltimore, Md.

Dr. Robert E. Bannon
Hanover, N. H.

Dr. John R. Dean
Los Angeles, Calif.

Dr. W. Edward Dewey
Battle Creek, Mich.

Dr. Laurence P. Folsom
South Royalton, Vt.

Office: American Academy of Optometry: 1502 Foshay Tower, Minneapolis 2, Minn.

The AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY serves as the official publication of the American Academy of Optometry. It is published monthly by the American Journal of Optometry Publishing Association under the editorial supervision of the American Academy of Optometry.

Publication Office: 1502 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

AMERICAN JOURNAL OF OPTOMETRY *and* ARCHIVES *of* AMERICAN ACADEMY OF OPTOMETRY

Vol. 25 — No. 7

CONTENTS

ORIGINAL PAPERS

A Clinical Evaluation of Compensation for Vertical Prismatic Imbalances. V. J. Ellerbrock 309

The Correction Lens. Part II. Julius Neumueller 326

Investigation of the Variation and the Correlation of the Optical Elements of Human Eyes. Part III. Chapter III. Solve Stenstrom by Daniel Woolf 340

EDITORIALS

British Socialized Health Program. Carel C. Koch 351

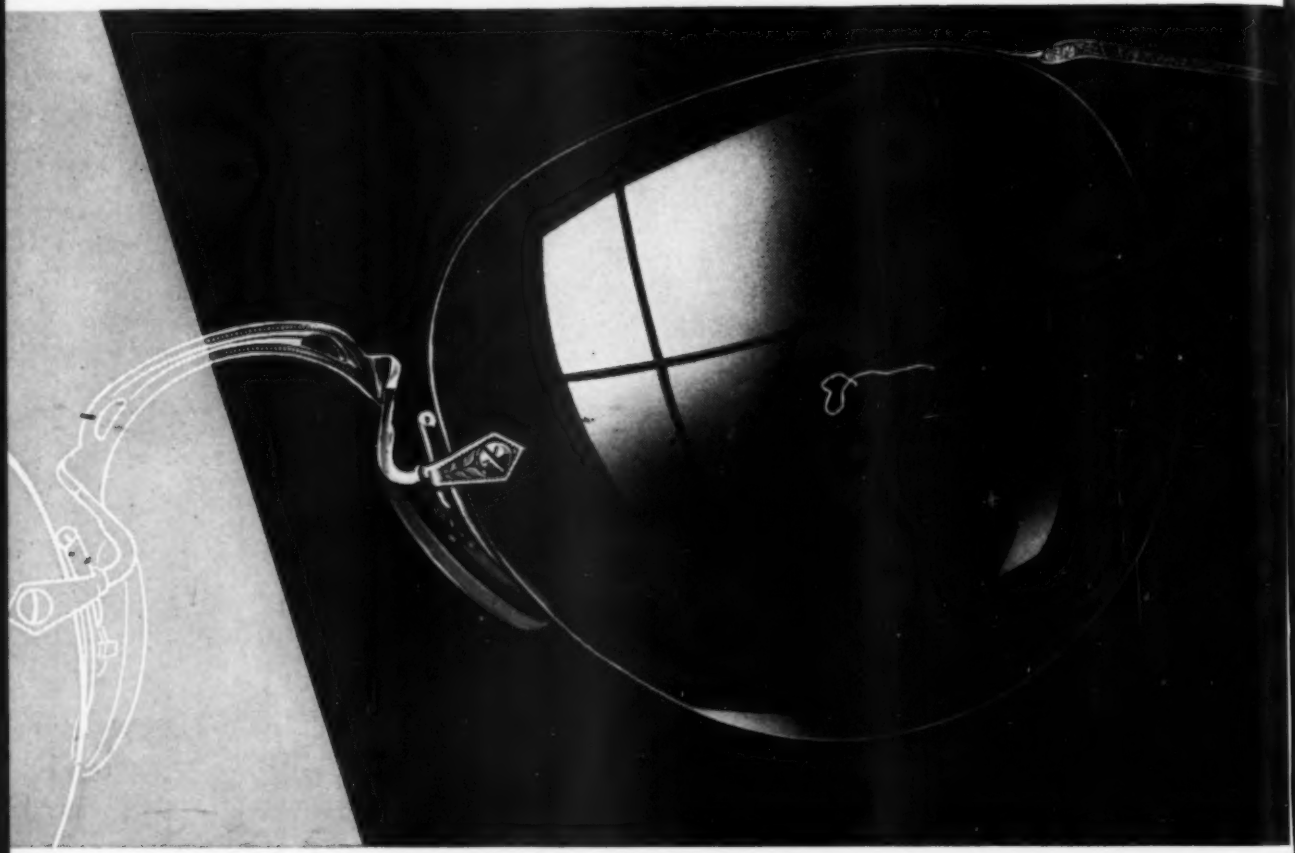
TRANSACTIONS OF THE ACADEMY 353

CORRESPONDENCE 356

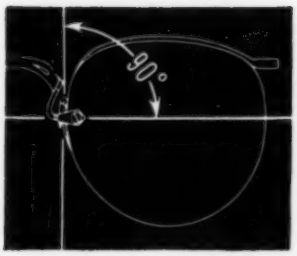
CURRENT COMMENTS 357

ANNOUNCEMENTS 358

~~NEW~~ *Proved Performance*



- PERMANENT LENS ALIGNMENT
- MAXIMUM SHOCK RESISTANCE
- SIMPLIFIED ASSEMBLY
- LIFETIME SPRING
- SECURE SCREW ATTACHMENT

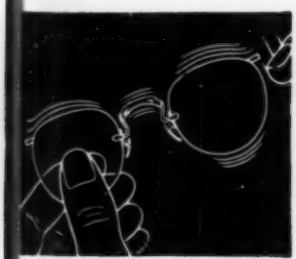


Permanent lens alignment . . . maintained by pressure of single-leaf spring holding lens against true rigid stop.

BAUSCH & LOMB NUMONT FUL-VUE

Flexmont

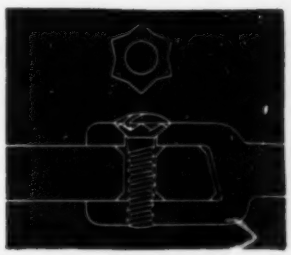
Bausch & Lomb Numont Ful-Vue Flexmont offers a combination of advantages to patient, to professional man, and to laboratory technician, never before found in a rimless mounting. Here is a spring strap mounting designed and built on scientific principles for permanent alignment, maximum shock resistance, long trouble-free service, and ease of assembly. Ask your Bausch & Lomb distributor's representative to show you the Flexmont shock test, a demonstration you can use to prove Flexmont superiority to your patients. Ask, too, to see the graceful, becoming Numont styles. You'll agree that Flexmont beauty and utility make it the popular choice for rimless eyewear champion.



Maximum shock resistance . . . spring suspension "rolls with the blow," absorbs strain, returns to alignment.

Simplified assembly . . . no shaping of shoe . . . no lens block . . . no hole filing . . . no need for lens strain test.

Lifetime spring . . . gold-filled for appearance and corrosion resistance, always quickly returns to shape.



Secure screw attachment . . . star washer bites in to screw head and countersink, prevents back up or loosening.

BAUSCH & LOMB

OPTICAL COMPANY B&L ROCHESTER 2, N. Y.

set for "ser

rvice"

It's "love all" for continually improved and modernly designed Konoptics. These creations make it possible to fit your patients with the ultimate in smartly fashioned frames. And the laboratory precision provided by Konoptics is your assurance of the ophthalmic perfection specified in your professional prescription.

a. MIDWAY—With generous masculine contour for rugged service for every man's man.

b. 17-A—The cosmetic minded teen-ager finds this design most flattering for youthful features.

c. CLIPPER E—Light-weight Konoptic—fits the face comfortably under all conditions.

d. HUSSY—Colorfully patterned "Highland plaid" for the glamorous girl who is always on the go.

e. PACEMAKER—A streamlined classic Konoptic with a modernly designed high bridge.

f. WINGER—A quietly styled Konoptic with original lines in lustrous seashell, jewel tones and calico.

– AVAILABLE THROUGH YOUR LOCAL SUPPLY HOUSE –

KONO

THE KONO MANUFACTURING COMPANY

88-24 FORTY-NINTH AVE., WOODSIDE, N. Y.

55 E. WASHINGTON ST., CHICAGO, ILL. • CHARLESTON, S. C.

SPORTS EQUIPMENT BY ABERCROMBIE & FITCH CO

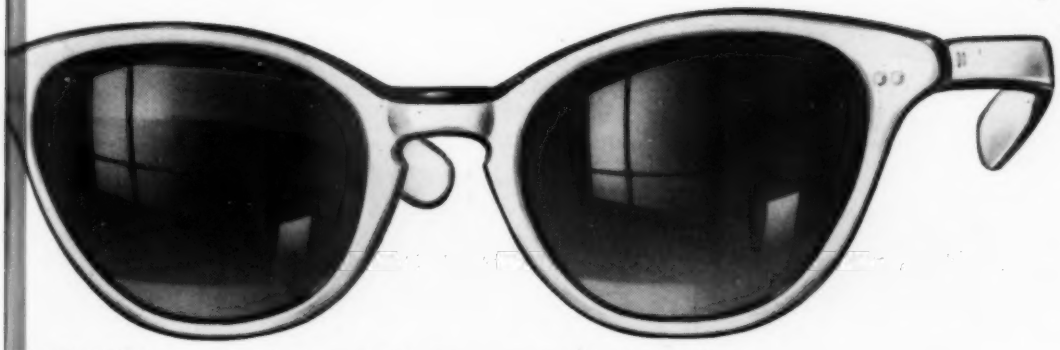
AO CALOBAR *Blazer* modern

NOW, the new AO Calobar BLAZER . . . in eight gay colorful frame styles . . . is offered exclusively to the Professions. Basically, the frame design is the same as the popular F-351 Sun Glass . . . but it is glamorized in harmonious color combinations. Colors are red, blue, green, or black, each combined with white in two different ways (as illustrated) giving a total of eight contrasting color choices.

Like you, we are acutely conscious that style is merely the "dress" for the ophthalmic properties of the frames and lenses. When you choose Calobar, you can be confident of ophthalmic accuracy . . . 6-base curve, optically ground and polished, scientifically decentered lenses. 46 mm. or 48 mm. eye sizes. Available now for immediate delivery from your nearest AO Branch Office.

colorful frame styles for

traditionally accurate calobar lenses



The BLAZER—available in red, blue, green or black on white.

Same color combinations reversed to give you four additional styles.

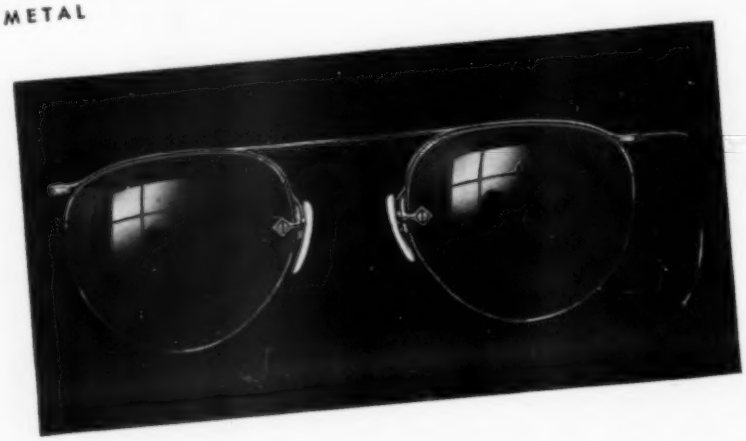
American Optical

COMPANY

From Our Style Book

WE RECOMMEND...*The Bentley!* Easy to fit, notable for comfort and lasting correctness of lens alignment, it is THE Arcway Ful-Vue mounting for patients who desire bar bridge smartness in eyewear.

THE ART OF DESIGNING IN METAL • THE CRAFT OF FASHIONING IN ZYL



The Bentley

STYLEFLO Arcway Ful-Vue streamlining . . . "No-Korod" Temples . . . Art-Craft quality throughout . . . make *The Bentley* a favorite with patients and practitioners. No. 5280—1/10 12K Gold Filled with 10K Gold Bridge.

Art-Craft OPTICAL COMPANY • ROCHESTER 6, N. Y.

BVI
String of Pearls
by VICTORY
Five lovely Pearl-HONEYS . . . in glamorous, glowing colors that are ideal for casual or dress wear.
The softly luminous mother-of-pearl overtones blend beautifully with every skin texture and hair coloring . . . are completely in harmony with spring and summer fashion trends. "Pearls" are available only in the sensationally-popular HONEY by Victory.
Order through your optical supplier
VICTORY OPTICAL
MANUFACTURING COMPANY
Factory & Main Office, Mulberry Place, Newark, N. J.
Branch Office, 5 North Wabash Avenue, Chicago, Ill.
PEARL GOLD • PEARL GREEN • PEARL RED • PEARL PINK • PEARL BLUE

THE QUALITY FRAME WITH
THE "MIRROR-LIKE" FINISH

Honey

by VICTORY

Order through your optical supplier

VICTORY OPTICAL
MANUFACTURING CO.
MULBERRY PLACE, NEWARK, N. J.
Branch Office:
5 NORTH WABASH AVE., CHICAGO, ILL.

Your presbyopic patients will want

UNIVIS GREEN*

* **Naturally.** Just because people are presbyopic, don't conclude that they do not like to enjoy the summer sun . . . and see while they're doing it! Are your presbyopic patients advised that they can get their prescriptions in green . . . in *Univis Green* on Univis prescriptions?

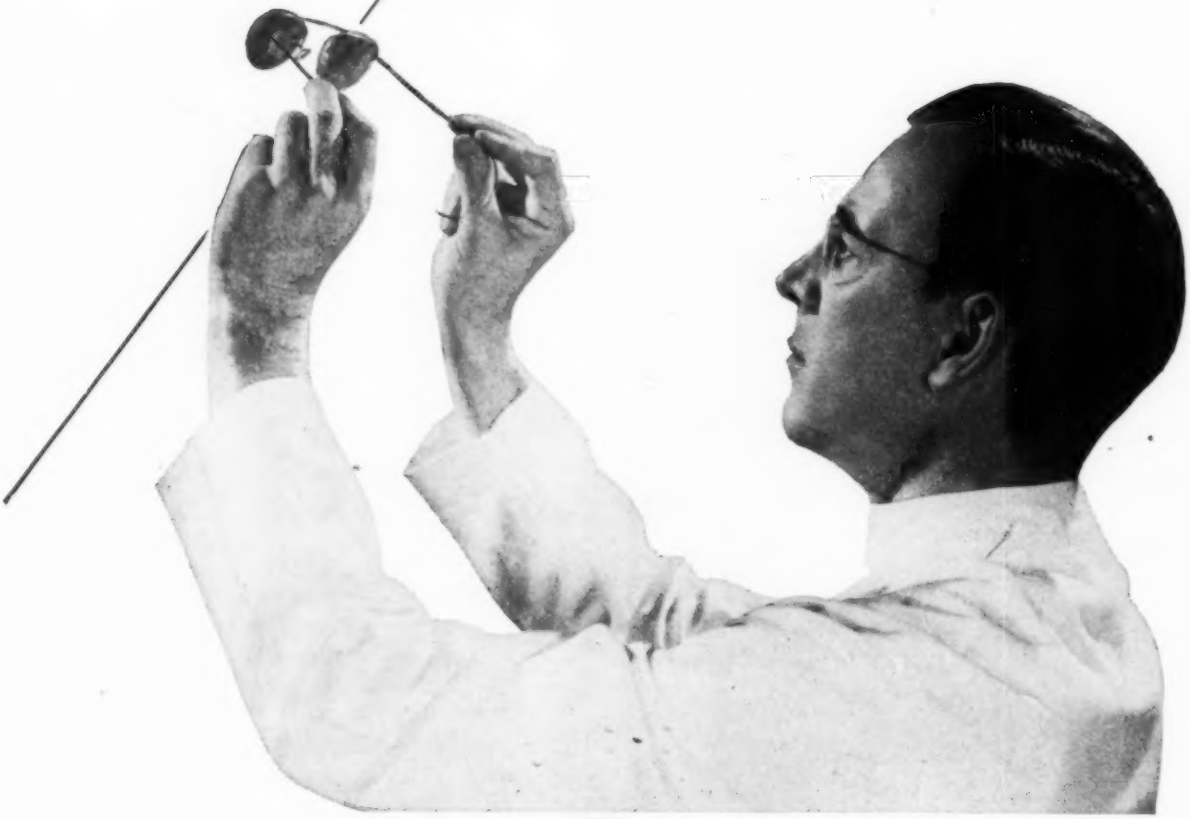
Univis Green is available in #3 (dark) shade. It comes in 60 mm D style blanks for most goggle shapes. Also available in styles R, B and the General Purpose Trifocal on special order.

THE UNIVIS LENS COMPANY • DAYTON 1, OHIO

here's an "add" that's not measured in diopters

Some things just can't be measured in specific units.
One of them is patient satisfaction.
Yet there's a very simple "add" that helps bring
about this most important ingredient
in the formulation of a successful practice.
It's the addition of comfort to correction
by specifying Soft-Lite via the finest in
Prescription Service . . . Roco, of course.
Over 40 years' experience attest to the
superiority of this satisfaction
winning, practice building team.

Riggs Optical Company



AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 25 JULY, 1948 No. 7

A CLINICAL EVALUATION OF COMPENSATION FOR VERTICAL PRISMATIC IMBALANCES*§

V. J. Ellerbrock†
School of Optometry, The Ohio State University
Columbus, Ohio

INTRODUCTION

The correction of anisometropia involves many more problems than is generally suspected. Principal among these are aniseikonia and differences of the prismatic effect through the two lenses at all points except the optical centers.**

Whether or not an aniseikonia is produced depends upon the nature of the ametropia and the position of the correction lenses in front of the eyes. If an eye is axially ametropic and the correcting lens is placed at the anterior focal point of the ametropic eye, the size of the image will be the same as though that eye were emmetropic. However, if the ametropia of an eye is due to a refractive condition, the size of the image of the corrected eye will be different from the image that would be produced were the eye emmetropic.‡

Aniseikonia can also be produced by an anomalous distribution of corresponding photoreceptors on the retinas. Thus, the distribution of the corresponding photoreceptors together with the dioptric power of

---

*Read before the annual meeting of the American Academy of Optometry, Philadelphia, Pennsylvania. For publication in the July, 1948, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

This investigation was made possible by a Univis Lens Company research grant-in-aid which included the necessary compensated lenses.

†Optometrist. Fellow, American Academy of Optometry. Research Fellow in Physiological Optics, The Ohio State University, Columbus, Ohio.

**Aniseikonia can be defined as an anomalous incongruity between the images from the two eyes. "Normal binocular spatial localization is based on a normal incongruity of the ocular images due to the separation of the two eyes. Where the incongruity of the ocular images differs from the normal, anomalous spatial localization will result."[2] The instrument designed by the Dartmouth Eye Institute to measure the amount of the anomalous spatial localization is called the space eikonometer.[1c]

‡A particularly good description of the effect on image size produced by the correction of axial and refractive ametropia has been published by K. N. Ogle[1a] (cf. Bibliography).

§Author's abstract, page 325.

the eye determines whether a given ametropic eye when corrected by an ophthalmic lens acts as an axial or refractive or a combined axial-refractive ametropia.

Because the nature of an ametropia as well as the position of the corresponding photoreceptors cannot be objectively determined, it is necessary to rely upon subjective tests for aniseikonia. For the same reasons, the amount and type of aniseikonia cannot be deduced from the power of the lenses required to correct an anisometropia.

The correction of aniseikonia requires the employment of an afocal lens which produces a small magnification.*[1a,1b] Such a lens likewise

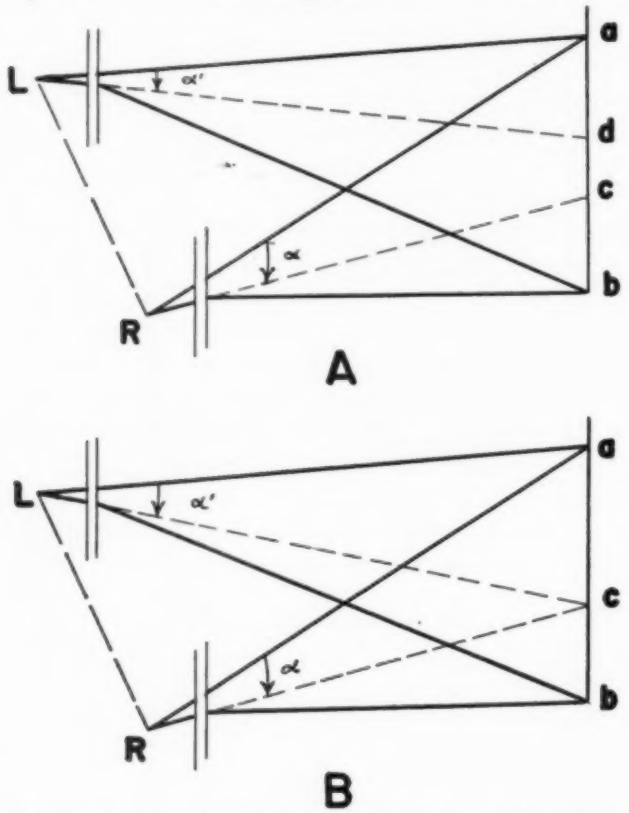


Fig. 1—Schematic illustration of a peripheral prismatic imbalance (a—a') encountered when the gaze is shifted from a to b (A above). The line of sight of the right eye is directed toward c while that of the left eye is directed toward d. In B, the lines of sight of both eyes are directed toward the same point (c) indicating that no prismatic imbalance is produced when the gaze is shifted from a to b. The letters L and R designate the centers of rotation of the left and right eyes respectively.

*Afocal lenses having small magnifications are commonly known as size lenses and are commercially distributed by the American Optical Co. under the trade name "Iseikonic Lenses."

produces a prismatic effect at all points other than the one penetrated by the optic axis (Figure 1).

It has been found than anisometropia oftentimes results from an unequal refractive ametropia of the two eyes.[1a] The correction of this condition by lenses may produce aniseikonia. When the aniseikonia so produced is corrected by size lenses, prismatic effects are produced in the peripheral parts of these lenses which in turn may either increase or decrease the prismatic imbalance due to the correcting ametropic lenses. The determining factors will be the origin of the aniseikonia and the anisometropia.[3] Usually, the origin of the aniseikonia is such that its correction decreases the prismatic imbalance resulting from the lenses required for the correction of the anisometropia.

The correction of both aniseikonia and anisometropia has been followed by rather remarkable results.[5a, 5b, 6, 7] For example, Burian found that unless there were other complicating factors, it was possible to correct anisometropia fully in every case provided the size difference was measured and corrected together with the refractive error.[8] When a full correction of high anisometropia was attempted without the correction of aniseikonia, the patients experienced discomfort, eyestrain, and even diplopia.

Because all anisometropes encounter peripheral prismatic imbalance if an existing aniseikonic condition has not been corrected and because the majority of them must cope with varying amounts of prismatic imbalance even when their aniseikonia is corrected, the possibility existed

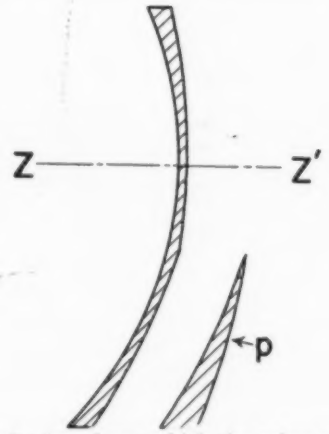


Fig. 2—Cross section of a lens from which the prism segment p has been removed.

that any neutralization of the prismatic imbalance might prove to be beneficial. If such neutralization could be accomplished, beneficial effects

would be expected because some of the demands which are placed upon the fusion mechanisms will have been eliminated. Fortunately, an optical means by which prismatic imbalance can be neutralized is available. It is a grinding technique by which a prism segment can be removed from any portion of an ophthalmic lens (Figure 2). By the use of a lens from which a prism segment has been removed there can be provided two specific positions of the direction of gaze at which no prismatic imbalance is encountered: namely, when the lines of sight pass through the optical centers and when they pass through the points on the lenses chosen for prismatic compensation (Figure 3). At all other positions varying amounts of prismatic imbalance have to be overcome by the fusion mechanism.

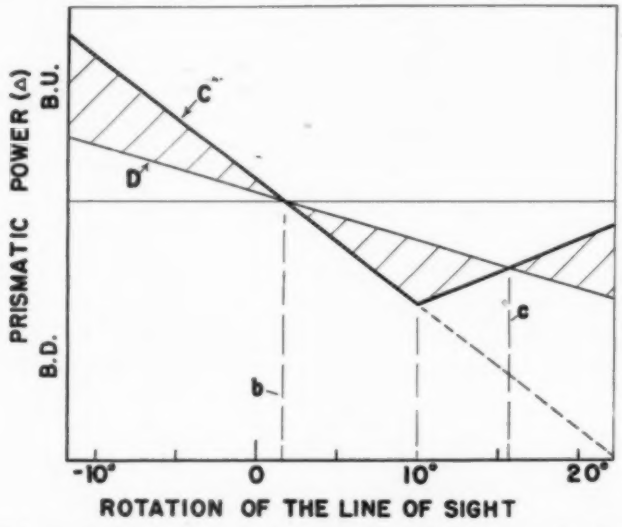


Fig. 3—Schematic illustration of the prismatic effects of a pair of anisometropic lenses with rotation of the lines of sight. Curve C represents the prism power of one lens while D represents the prism power of the other. The shaded area between the two curves indicates the prismatic imbalance. It should be noted that no prismatic imbalance is found at the positions of the lines of sight indicated by b and c.

The range of fusional convergence and divergence is usually large; for this reason, the prismatic inequality encountered in lateral excursions can cause little or no difficulty. However, the amplitude of positive and negative vertical divergence is usually very small and, here, the prismatic inequality encountered in upward or downward gaze could conceivably produce visual discomfort. Since the eyes are turned down in the reading position for long intervals of time where large prismatic imbalances are encountered, the removal of a prism segment is usually

confined to the lower part of a lens to neutralize the prismatic imbalances at the reading level.

An investigation, which has been completed, indicates the importance of compensation for prismatic imbalance without the correction of aniseikonia. For this reason, the remainder of this paper will be restricted to the presentation and discussion of a method employed to determine prismatic imbalance and the clinical results secured by the use of lenses from which prism segments have been removed.

METHOD USED TO DETERMINE PRISMATIC IMBALANCE

The position of the head as well as the position of the lenses in front of the eyes determine the amount of prismatic imbalance for an anisometrope at any direction of gaze. These variables made necessary the development of some method so that the position of the lenses before the eyes could be objectively measured while the head position was fixed. It was found that this could be done photographically by an instrument which was developed and called a topometer.

The topometer has been fully described in the literature[10a] and, consequently, a detailed description of it is not warranted in this report. It is sufficient to state that it is an instrument designed for the photographic recording of the position of a pair of lenses mounted in front of the eyes when the face plane is vertical.* A sample of a photographic record is illustrated in Figure 4. By virtue of the optical system, orthographic projection is obtained in both the front and side views. The orthographic projection feature makes it possible to set the points of a pair of dividers corresponding to any pair of points in the front or side view photograph and then measure the

Fig. 4—Front and side view photographs of the position of a pair of lenses in front of the eyes when the face plane was vertical. The center of the white dashes designates the optical centers of the lenses. The scales in the upper part of the photograph are calibrated in mm.

*The face plane is defined as the plane which just touches the chin and the two superciliary ridges.

distance by applying the dividers to the scale in the upper part of the photograph.

In the ordinary use of the eyes, head movements accompany eye movements. In fact, movements of the head even accompany very small eye movements and increase proportionately with the latters' magnitude. But the proportion between the head and eye movements shows great individual variation. Because of this an instrument was developed to measure the reading positions of the lines of sight with respect to the face plane. The instrument consists essentially of two pieces of transparent celluloid, which rotate about a fixed dowel pin. On each piece of celluloid there is a long narrow line: on one, a vertical, and on the other a horizontal (Figure 5).

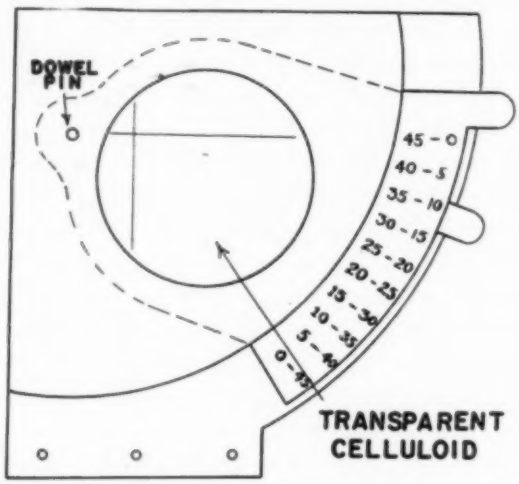


Fig. 5—Outline drawing of instrument developed to measure the reading positions of the lines of sight with respect to the face plane.

The two pieces of celluloid are mounted between two pieces of pressed wood with a large opening at the center of each. This, in turn, is mounted on a table with the center of the opening approximately 48 inches from the floor. This height was chosen because it approximates the average eye level of adult individuals when sitting.

The procedure was to have the patient sit sidewise about 4 feet from the instrument. He was instructed to hold the reading material which was given him in his normal reading position. The operator would place himself on the opposite side of the instrument and line up the vertical line with the patient's eyebrow and chin, and then the horizontal line with the center of rotation of the eye and the center of a small paragraph of reading material the patient was reading. The

tilt of the face plane from the vertical and the depression of the line of sight below the horizontal plane of the head could then be read directly from the scales.

The scale for the vertical line is fixed with respect to the instrument. The scale for the horizontal line is marked on the piece of celluloid carrying the vertical line. Consequently, for each position of the vertical line, the zero position of the horizontal line is always perpendicular to the vertical. Hence, when the vertical line is lined up with the face plane the zero position of the horizontal line corresponds to the horizontal plane of the head.

Five separate determinations of the depression of the line of sight were made for each patient and the average was taken as representative of the patient's habitual reading position. The measurements were usually made with the patient seated in a straight chair, and he was seated at a desk when most of his near work was of this type.

By the use of the two instruments which have just been described, it was possible to determine the points on the lens surfaces penetrated by the straightforward and reading positions of the lines of sight

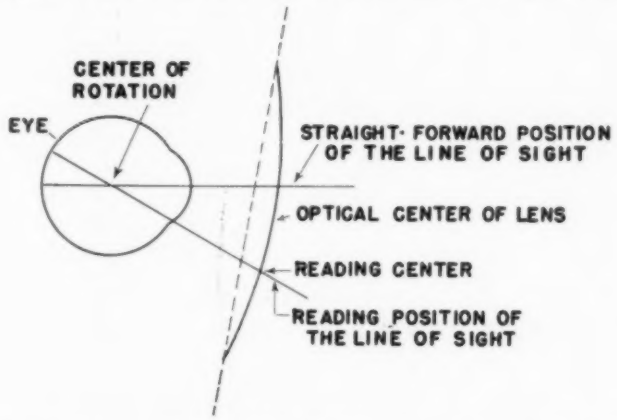

CENTER OF ROTATION
EYE
STRAIGHT-FORWARD POSITION OF THE LINE OF SIGHT
OPTICAL CENTER OF LENS
READING CENTER
READING POSITION OF THE LINE OF SIGHT

Fig. 6—Sectional drawing of eye and lens showing the method used to determine the points on the lenses penetrated by the straightforward and reading positions of the lines of sight.

(Figure 6). With this information it was then possible to provide compensated lenses which, when placed in the patient's spectacle frame, did not produce a prismatic imbalance at either the straightforward or reading positions of the lines of sight.* This was made possible by

*The term uncompensated lenses will be used for ordinary ophthalmic lenses without prismatic compensation, while compensated lenses will be used to designate those with prismatic compensation.

placing the optical centers of these lenses at the points penetrated by the lines of sight in the straightforward position and by slabbing-off a prism segment of an amount equal to the prismatic imbalance at the patient's habitual reading position.[10b]

All the patients used in this investigation had a vertical anisometropia of at least one diopter and had visual acuity of at least 20/50 in both eyes. No limitations were placed on the size of the phorias at either distance or near but all cases were able to maintain single binocular vision.

POSITIONS OF THE LINES OF SIGHT AND
THE FACE PLANE AT THE READING POSITION

In Figure 7 is shown a plot of the tilt of the face plane and the depression of the lines of sight when the eyes are in the reading position

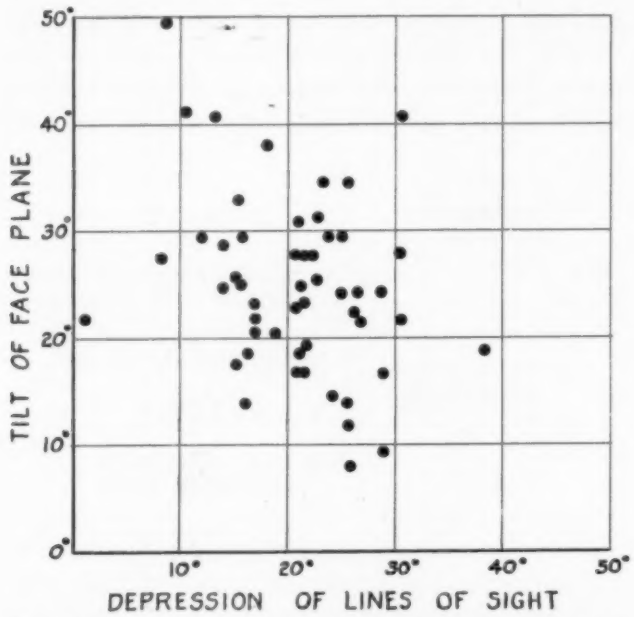


Fig. 7—Plot of the tilt of the face plane and the depressions of the lines of sight at the habitual reading position. Each subject had a vertical anisometropia of at least one diopter.

for the group of anisometropic patients which were studied. The tilt of the face plane was measured from its vertical position; the depression of the lines of sight was measured from their straightforward positions.*

*The lines of sight are in their straightforward position when the plane of fixation is perpendicular to the face plane and the lines of sight are perpendicular to the base line.

Each point represents an average value of five separate measurements of a patient's habitual reading position. The data show that patients with anisometropia usually do not avoid peripheral vertical prismatic imbalances at the reading position by movements of the head.

It is conceivable that the maximum and minimum tilts of the face plane at the reading position are correlated with the amount or type of vertical anisometropia. That such correlations do not exist is demonstrated by the data given in Tables 1 and 2.

Table 1. Data of five patients who had the largest tilts of the face plane at the reading position.

Case No.	Refractive Correction	Tilt of Face Plane	Av. Dev. of Five Measurements	Depression of Lines of Sight	Av. Dev. of Five Measurements
16	−3.75 + 0.50 X 75 −1.50 + 0.25 X 170	38.0°	±3.6°	18.3°	±3.4°
32	−0.25 − 0.25 X 175 +0.25 − 1.25 X 10	40.5°	±4.0°	30.6°	±2.8°
56	+0.25 +1.50 + 0.50 X 75	40.8°	±1.9°	13.6°	±2.1°
63	+1.00 − 0.50 X 20 +3.00 − 0.50 X 180	41.2°	±16.4°	10.5°	±6.0°
65	+4.75 − 3.00 X 20 +2.25 − 2.00 X 155	49.5°	±1.9°	8.2°	±0.2°

Table 2. Data of five patients who had the smallest tilts of the face plane at the reading position.

Case No.	Refractive Correction	F.P.	Av. Dev.	L. of S.	Av. Dev.
28	+0.25 X 180 +0.25 2.00 X 175	14.0°	±2.8°	25.5°	±2.2°
35	−7.50 + 1.25 X 107 −8.87 + 1.12 X 88	13.6°	±1.9°	16.6°	±3.2°
38	−5.00 − 1.00 X 180 −3.25 − 0.25 X 180	11.3°	±2.0°	25.6°	±1.2°
58	+3.00 − 1.00 X 85 +4.25 − 1.25 X 95	8.5°	±1.4°	26.2°	±0.6°
68	−0.75 +0.50	9.3°	±3.0°	29.5°	±5.3°

THE SUBJECTIVE REACTIONS OF THE PATIENTS TO THE UNCOMPENSATED LENSES†

The difficulties which an anisometrope is apt to encounter can be classified in terms of: headaches, other asthenopic symptoms, and diplopia. In order to evaluate the relation of prismatic effects in uncompensated lenses to the presence or absence of headaches and other asthenopic symptoms, the anisometropes were classified into four groups as follows:

†The prismatic imbalance of uncompensated lenses produces objective changes in the relative position of rest of the eyes. These effects have already been discussed in the literature.[11]

1. Headaches and additional asthenopic symptoms.
2. Headaches only.
3. Asthenopic symptoms other than headaches.
4. No asthenopic symptoms.

For the purpose of making this classification, the following definitions were adhered to:

Headaches—If an individual experiences any headaches—of any location and any duration—he was included in this group. Frequency—at least twice over a two-week period.

Other asthenopic symptoms—Eyes tire easily, burn, itch, become excessively dry. Strain, in or about the eyes which cannot be localized. Drowsiness, excessive blinking and closing of the lids.

No asthenopic symptoms—Only the absence of all asthenopia, diplopia and headaches warranted a case to be included in this group.

In Figure 8 the various anisometropes are plotted according to the habitual depression of the lines of sight in reading and the amount

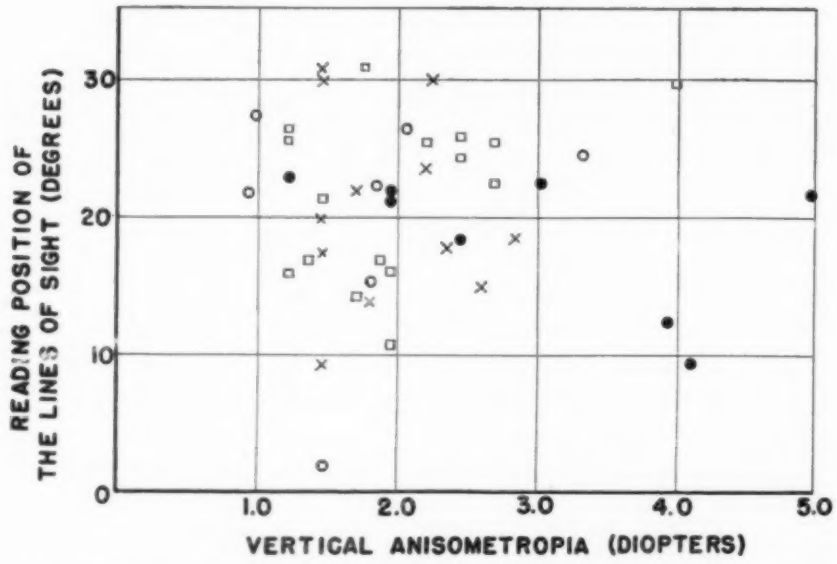


Fig. 8—Plot of the report of symptoms by patients with the habitual reading positions of the lines of sight and vertical anisometropias. The various symbols indicate the following:

O Asthenopia only
X Headaches and asthenopia
□ Headaches only
• No Difficulty

of vertical anisometropia.* The different groups of anisometropes are represented by the various symbols. There does not seem to be any relation between asthenopic symptoms and reading depth and vertical anisometropia. In general the greater the reading depth and the greater the anisometropia, the more difficulty would have been anticipated.**

In regard to diplopia only two cases were found in which diplopia was reported when the eyes were directed straight ahead during distant visual tasks. A number of cases, however, reported diplopia while in the reading position. In some cases this diplopia occurred momentarily after shifting from the straight ahead to the reading position. In other cases it was experienced only after one-half hour or more of near work.

In every case, however, the diplopia was intermittent. That is, it might be experienced at one time and not another. Because of its intermittency, the problem presented itself wherein there might be some relationship between asthenopia, headaches and diplopia. If there were a relationship, it would probably indicate that the diplopia was experienced when the discomfort from the maintenance of single vision became too severe. That such a relationship does not exist is shown in Table 3.

TABLE 3

	Headaches & Other Asthenopic Symptoms	Headaches Only	Asthenopia Only	No Asthenopic Symptoms
Number of Cases with Diplopia	0	11	4	4
Number of Cases without Diplopia	8	10	5	5

The distribution of cases with diplopia corresponds quite closely to the distribution of cases without diplopia.

THE SUBJECTIVE REACTIONS OF THE ANISOMETROPES TO THE COMPENSATED LENSES

Figure 9 gives a comparison of the asthenopic symptoms reported by the patients while wearing the uncompensated lenses with the reports after wearing the compensated lenses approximately two weeks. Of the 47 cases used in this analysis, 29 reported that they did not have any difficulty or discomfort from the compensated lenses. Twelve reported asthenopia only, three headaches only, and three both headaches and

*The symptoms and difficulties of each patient to both uncompensated and compensated lenses were secured by means of a detailed check list. Throughout the course of the experiment on each subject, utmost caution and tact were used so as not to bias or influence his judgments.

**The point in a lens intersected by the line of sight is shifted approximately one mm. for a 2° rotation of the eye.

Asthenopia

Fig. 9—Report of patients while wearing the compensated and uncompensated lenses.

	No Headaches or Asthenopia		Asthenopia only		Headaches only	Headaches and Asthenopia
Headaches and Asthenopia	*2.7		*2.9	*1.7		2.2
	*2.4		*2.7	*1.4		
			*1.8			
Headaches only	3.0	*2.5	2.1		5.2	3.0
	*2.9	*2.3	1.6		*3.3	4.0
	2.7	*2.2			3.2	
	*2.5	*2.0				
	*2.5	1.9				
		1.8				
		1.8				
		*1.3				
Asthenopia only	5.2		7.7			
	*2.7		3.3			
	*2.0		1.9			
	*1.5					
	*1.2					
	*1.1					
No Headaches or Asthenopia	*4.6	2.5	2.6			
	3.4	1.8	2.2			
	3.2	1.4				
	*2.7					

Fig. 9—Illustration of the reports of asthenopic symptoms while wearing uncompensated lenses with the reports after wearing the compensated lenses approximately two weeks. Each number represents one patient and is the amount of slab-off prism in diopters that was incorporated in the compensated lenses. The asterisks indicate the patients who reported the compensated lenses better than the uncompensated lenses.

asthenopia. Thus, the general trend is toward fewer asthenopic symptoms after wearing the compensated lenses, indicating very definitely that the compensated lenses constitute an improvement over the uncompensated lenses.†

All of the patients for whom compensated lenses were prescribed had difficulty in becoming adjusted to the slab-off line. This difficulty lasted for varying periods of time reaching a maximum for those individuals who had not become accustomed to the slab-off line after a two-week period to a minimum for those patients who reported that the line did not bother them after the second day. Younger individuals seemed to become accustomed to the line in shorter periods of time than those more advanced in years. All the individuals who finally learned to tolerate the line reported that it ceased to trouble them after they had learned to hold their heads in such a position that the line did not cross their field of direct vision during near work. In many cases

†Cusick and Hawn made a limited study of the clinical value of prism compensation in cases of anisometropia and arrived at the same conclusion.

where the patients complained about the slab-off line after wearing the compensated lenses for two or three days, it was possible to relieve the trouble by readjusting the glasses so that the slab-off line fell at a higher or lower level.

In six of the cases, the slab-off line proved to be such a troublesome factor that the patients chose to wear the uncompensated lenses after the two-week trial period with the compensated lenses. In three of these cases, the difficulty was simply of the slab-off line having been placed too high, and the situation could not be adjusted down on the face. In the other three cases the patient apparently was unable to become adjusted to the line, regardless of its position. Furthermore, in each of these cases, the habitual reading level was quite low and there was no discernable basis for the lines interfering directly with near work.

Table 4 provides the reports of the patients who were asked specifically whether the compensated lenses were the same, worse or better than the uncompensated lenses, disregarding any difficulty that could be attributed directly to the slab-off line. Of the 50 cases reported, 21 said they could not tell any difference between the

TABLE 4

Amount of slab off on the minus lens (Δ)	Patient's* report			Amount of slab off on the plus lens (Δ)	Patient's* report		
	Better	Worse	Same		Better	Worse	Same
1.00–1.24	2			1.00–1.24			
1.25–1.49	2			1.25–1.49	1		
1.50–1.74	1	1		1.50–1.74	2		
1.75–1.99	1		3	1.75–1.99	1	1	
2.00–2.24	2		1	2.00–2.24		1	2
2.25–2.49	1			2.25–2.49	2		
2.50–2.74	2	1	1	2.50–2.74	3		
2.75–2.99	5		1	2.75–2.99			1
3.00–3.24			2	3.00–3.24			
3.25–3.49	1		1	3.25–3.49		1	
3.50–3.74				3.50–3.74			
3.75–3.99				3.75–3.99			
4.00–4.24				4.00–4.24		1	
4.25–4.49				4.25–4.49			
4.50–4.74			1	4.50–4.74	1		
4.75–4.99				4.75–4.99			
5.00–5.24			1	5.00–5.24	1		
5.25–5.49				5.25–5.49			
5.50–5.74	1			5.50–5.74			
7.50–7.74			1				
TOTAL	18	2	12	TOTAL	11	4	3

Total Number of Cases..... 50

*Disregarding the difficulty due to the slab-off line, the report of all the patients in the columns marked worse was that they could tell no difference between the compensated and the uncompensated lenses.

comfort secured with the uncompensated and the compensated lenses. The remaining 29 cases reported the compensated lenses as being better than the uncompensated lenses. The patients usually reported "better" when they had alleviation of any discomforts or difficulties which were experienced while wearing the uncompensated lenses. This is shown in Figure 9.

All of the patients chose to keep the compensated lenses in preference to the uncompensated lenses except the six referred to above, whose preference was based entirely on the trouble they were having with the slab-off line.

In regard to diplopia with the compensated lenses, a few cases reported diplopia which proved in the final analysis to be nothing more than the double image which can be obtained by looking at an object that falls directly in front of the slab-off line. There was only one case who reported true binocular diplopia while wearing the compensated lenses. In this case, a right hyperphoria of 4.0 prism diopters combined with a right infraduction measurement of —1.8 prism diopters was found at the reading level at the time the compensated lenses were first worn. This diplopia could be overcome with a tilting of the head and was not experienced at the end of the two-week trial period.

It is conceivable that the age of the patient might have some relationship with his subjective report. That this is actually so is shown in Table 5. The majority of patients under 25 years of age reported the compensated lenses "better" that the uncompensated lenses, while the majority of those over 25 years reported no difference between the compensated and the uncompensated lenses.

TABLE 5

Age Groups	Under 16 yrs.	16-25 yrs.	Over 25 yrs.
Number Reporting Better	3	25	1
Number Reporting Same	1	13	7

Three selected cases were chosen to demonstrate the different types or reactions to the wearing of the compensated lenses.

CASE 1.

A man, age 24, complained of frontal and occipital headaches which usually occurred in the evenings while at the movie. He occasionally had diplopia when beginning to read. The lines of print at first appeared in various shades of gray and would then double. When he was able to see single, he could read for only a very short period of time. His correction was:

O.D. —6.00 D.sph.⌒ —0.87 D.cyl.axis 20
O.S. —3.75 D.sph.⌒ —0.75 D.cyl.axis 160.

His visual acuity with this correction was:

O.D. 20/20-1; O.S. 20/20-1; O.U. 20/20-1.

With this prescription, he had 1.45△ base-up prismatic inequality at the straightforward position and .66△ base-down at the reading position. The optical centers were placed in the straightforward position and 2.17△ base-down O.D. slab-off was prescribed for the compensated lenses. With his compensated lenses, he reported that he was able to sit through a whole movie without any difficulty and could read for long periods of time without any doubling or discomfort.

CASE 2.

A man, age 31, complained of momentary doubling when shifting from distance to near vision. He became drowsy after 30 minutes of close work. After an hour or so of near work, he frequently was troubled with a diplopia. He tilted his head toward his shoulder while doing near work. His correction was:

O.D. + 1.00 D.cyl.axis 90
O.S. — 8.25 D.sph.

Visual Acuity	Reading
Straight Ahead Position	Position
O.D. 20/30-1	20/20-4
O.S. 20/40-1	20/30-2
O.U. 20/20-6	20/20-6

With the uncompensated lenses at the straightforward position he had 3.46△ base-down prismatic inequality and at the reading position 4.29△ base-up. In the compensated lenses the optical centers were placed in the straight ahead position and 7.71△ base-down O.S. slab-off was prescribed.

After wearing the compensated lenses, he reported that he *could not* tell any difference between the compensated and uncompensated lenses except that the slab-off line troubled him in the compensated lenses. The latter caused him to have momentary diplopia when shifting from distant to near vision.

CASE 3.

A man, age 36, had no complaint whatsoever from the use of his antisometropic correction.

His correction was:

O.D. — 4.25 D.sph. ⌒ — 1.75 D.cyl.axis 160. V.A. = 20/30
O.S. — 1.25 D.sph. ⌒ — 2.75 D.cyl.axis 15. V.A. = 20/30

With the uncompensated lenses at the straightforward position, he had .68△ base-up prismatic imbalance, and at the reading position 2.08△ base-down imbalance. The optical centers were placed in the straightforward position and 2.64△ base-down O.D. slab-off prism was prescribed in the compensated lenses.

After wearing the compensated lenses three days he reported that he was having considerable difficulty with the line. It had been placed in the correct position, and later adjustments did not alleviate his trouble. He reported that with the slab-off lens he had to look up or down to avoid the "blur" of the line especially when doing close work. This effort reportedly caused his eyes to become more tired than with his uncompensated lenses. He also now noticed a tilting of his head. He definitely had *more trouble* with the compensated lenses than with the uncompensated lenses.

CONCLUSIONS

1. Of the 47 patients used in this investigation, eight or 17 per cent, with moderate and high vertical anisometropia had no difficulty with their uncompensated lenses. This would indicate that for anisometropic patients the indiscriminate use of lenses from which prism segments have been removed is unwarranted.
2. Twenty-nine patients (61 per cent) reported that they were more comfortable and encountered less visual difficulties with the compensated lenses than with the uncompensated lenses. Because of these findings it is recommended that prismatic compensation be provided for anisometropic patients who are uncomfortable with their uncompensated lenses before any consideration is given to an aniseikonic condition and its correction.
3. If an anisometropic patient wearing compensated lenses has symptoms which indicate a fusional difficulty, it then appears desirable to make a thorough test for aniseikonia.
4. Practically all patients can be expected to have difficulty with the line of the prism segment in their first attempts to use prismatic compensated lenses. However, only a few will not become accustomed to it after a two-week trial.
5. Younger patients (25 years of age and under) can be expected to be aided more by prismatic compensation than those over 25 years.

The clinical value of prismatic compensation for anisometropes with poor vision was not determined in this investigation. However,

the findings of Cusick and Hawn indicate that the presence of poor vision in one eye does not obviate the necessity for compensation if binocular single vision is shown to be present by the usual tests.[12]

BIBLIOGRAPHY

1a. Ogle, K. N.: Some Aspects of the Eye as an Image-Forming Mechanism, J.O.S.A., 33: 506-512, 1943.

b. —— : The Correction of Aniseikonia with Ophthalmic Lenses, J.O.S.A., 26: 323-337, 1936.

c. —— : Theory of the Space Eikonometer, J.O.S.A., 36: 20-32, 1946.

2. Ames, A. Jr.: The Space Eikonometer Test for Aniseikonia, Am. J. Ophth. 28: 248-262, 1945.

3. Burian, H. M. and Ogle, K. N.: A Study of Aniseikonia in a Case of Increasing Unilateral Index Myopia, Am. J. Ophth. 26: 480-490, 1943.

4. Friedenwald, J. S.: Diagnosis and Treatment of Aniseikonia, Arch. Ophth. 15: 283-307, 1936.

5a. Carleton, E. H. and Madigan, L. F.: Size and Shape of Ocular Images. II. Clinical Significance. Arch. Ophth., 7: 720-738, 1932.

b. —— : Relationships between Aniseikonia and Ametropia—From a Statistical Study of Clinical Cases. Arch. Ophth., 18: 237-247, 1937.

6. Madigan, L. F., and Carleton, E. H.: A Clinical Report on the Corrections of Differences in the Size and Shape of Ocular Images. The Annals of the Distinguished Service Foundation of Optom., 1: 71-92, 1932.

7. Bannon, R. E.: Practical Aspects of Aniseikonia, Am. J. Optom. and Arch. Am. Acad. Optom. 19: 239-257, 1942.

8. Burian, H. M.: Clinical Significance of Aniseikonia, Arch. Ophth. 29: 116-133, 1943.

9. Ellerbrock, V. J.: Some Effects Induced by Anisometropic Corrections, M. Sc. Thesis, The Ohio State University, Columbus, Ohio, 1941.

10a. Fry, G. A. and Kehoe, J. C.: An Instrument for Photographic Recording of the Position of a Pair of Lenses Mounted in Front of the Eyes, Am. J. Optom. 17: 502-510, 1940.

b. —— An Empirical Method of Determining the Vertical Prismatic Effect at the Reading Center of a Lens, Am. J. Optom. 17: 543-551, 1940.

11. Ellerbrock, V. J. and Fry, G. A.: Effects Induced by Anisometropic Corrections, Am. J. Optom. and Arch. Am. Acad. Optom. 19: 444-459, 1942.

12. Cusick, P. L. and Hawn, H. W.: Prism Compensation in Cases of Anisometropia, Arch. Ophth. 25: 651-654, 1941.

Author's Abstract. The correction of anisometropia produces unequal prismatic effects when the gaze is directed through the peripheral portion of the correcting lenses. The correction may also produce aniseikonia. The relationship of these two conditions is discussed. Experimental findings are presented by which an evaluation of compensation for prismatic imbalance is made. Slab-off prism grinding was employed for the compensation. Of the 47 patients used in the investigation, eight or 17 per cent with moderate and high vertical anisometropia had no difficulty with their uncompensated lenses. Twenty-nine patients (61 per cent) reported that they were more comfortable and encountered less visual difficulties with the compensated lenses than with the uncompensated lenses.—V. J. Ellerbrock.

THE CORRECTION LENS*

Julius Neumueller†
Pennsylvania State College of Optometry
Philadelphia, Pennsylvania

PART II

The Lens Surface.
The Effect of Power and Position of the Correcting Lens on the Ophthalmometric Reading.
Effect of Power and Position of the Correcting Lens on Accommodation, Addition and Presbyopia.
Prismatic Effect of Single Vision Lenses.
Prismatic Effect of Bifocal Lenses.
Prismatic Effect in Anisometropic Corrections.

THE LENS SURFACE

The ophthalmic lens is a piece of glass bound by two optical surfaces. We distinguish between spherical surfaces with equal curvature and power in all meridians and cylindrical surfaces with maximal and zero surface power in the two principal meridians at right angles one to the other.

The dioptric power of a surface is expressed by

$$D=\frac{n-1}{r}$$

where n is the index of refraction and r the radius.

A plano-cylindrical surface, Figure 18, shows a gradual change from zero to maximal power according to the function:

$$D_a = C \sin^2 a$$

and at right angles

$$D^1a = C \cos^2 a$$

so that

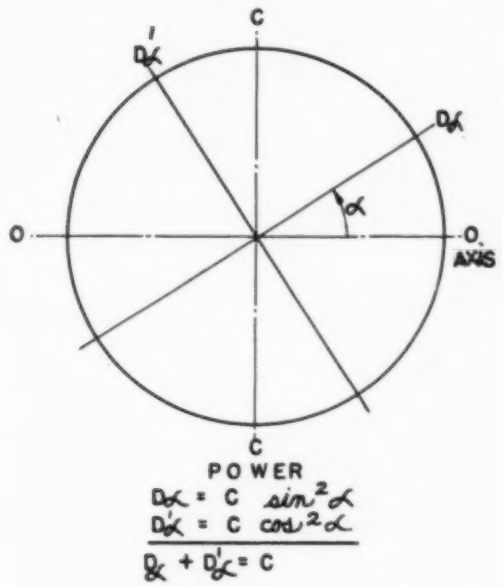
$$D_a + D^1a = C$$

The sum of the powers of any two meridians at right angles to one another of a cylindrical surface is equal to the power of the cylinder.

In order to reduce the aberrations of form, the lens is usually not flat but bent. Such a lens is called a toric lens. On a toric surface we distinguish the base meridian and the power meridian. The difference between the two powers in these meridians constitutes the cylindrical

*The second of a series of four articles. Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 15, 1947. For publication in the July, 1948, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist, Fellow, American Academy of Optometry, Professor of Optometry.



POWER OF CYLINDER IN OBLIQUE MERIDIAN

Fig. 18.

power. It is generally assumed that the power in the base as well as in the power meridian remains constant, regardless where it is measured. This, however, is an erroneous assumption.

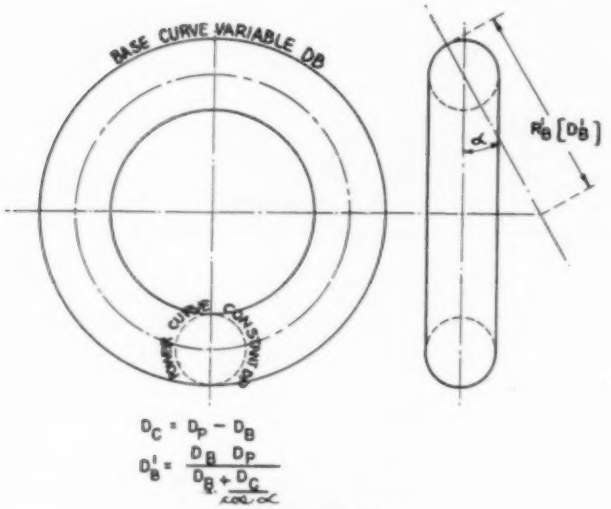
There are two kinds of toric surfaces, namely: the doughnut toric, Figure 19, and the spindle toric, Figure 20, so called because of their resemblance to these two well known bodies. Even a cursory examination of the doughnut toric shows that, while the power meridian has a constant curvature no matter where measured, the curvature of the base meridian varies from zero at the side of the doughnut to the maximum at its crest.

The spindle toric, on the other hand, shows a constant curvature in the base meridian but an increasing curvature from the crest to an infinitely high at the points of the spindle.

The ophthalmic industry grinds only doughnut torics, and so we shall consider only this form. The change of the base curve in the doughnut toric surface is found by the formula:

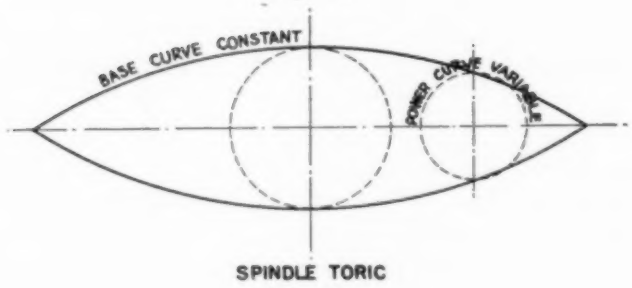
$$D_C = D_P - D_B$$

$$D'_B = \frac{D_B\, D_P}{D_B + \frac{D_C}{\cos\ \alpha}}$$



DOUGHNUT TORIC

Fig. 19.



SPINDLE TORIC

Fig. 20.

D_B is the dioptric power of the base meridian

D_P is the dioptric power of the power curve meridian

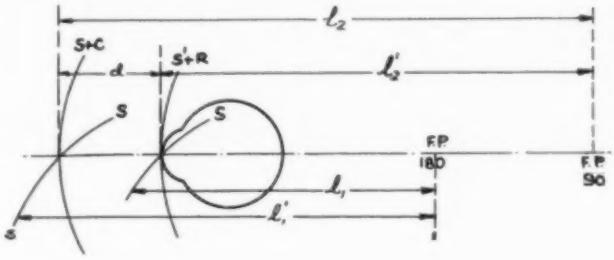
α is the angle enclosed by the planes of the base meridian and the vertical meridian.

The formula shows that the discrepancy increases with the curvature of the base and power curves. Fortunately, the center of rotation of the eye is generally much closer to the surface than the center of the ring of the doughnut. This reduces the discrepancy to about .2D for a 6D cylinder on a 9D base for an eye looking 30° off the straight-ahead position.

It is, of course, impossible to grind an absolutely true toric surface. The larger the tool the greater will be the influence of the discrepancy. For this reason cylindrical tools have their corners cut off to take the form of an octagon.

THE EFFECT OF POWER AND POSITION OF THE CORRECTION LENS ON THE OPHTHALMOMETRIC READING

Theoretically the correction lens should be applied at the principal plane of the eye, This, however, is impossible and the position of the correction lens is usually about 15 mm. in front of this plane. This lack of coincidence in position introduces various discrepancies between our measurements and the ultimate correction. The higher the ametropia, the greater are these discrepancies, Figure 21.



EFFECT OF POSITION AND POWER OF R_x LENS UPON FINAL R_x CYLINDER

Fig. 21.

The final correction cylinder frequently differs from that found by ophthalmometric measurements. Two factors enter into this consideration, namely, the power of the spherical component of the correction and the distance from the cornea to the lens. As the spherical correction S and the corneal astigmatism R occur in two different planes separated by a distance d, a direct addition of these two quantities is not permissible. The first step to be taken is to find the effectivity of S upon the plane of the cornea, which effectivity we shall call S′. Now the ophthalmometric reading R can be added to S′ which sum is then the power in the secondary principal meridian of the correction lens were it applied at the cornea. Retracing our step and finding the effectivity of this power (S′ + R) in the plane of the lens gives us the desired power in the secondary meridian of the lens (S + C), Figure 21.

$$S+C=\frac{S+R-dS'R}{1+dR-d^2SR}$$

$$C=\frac{R\,(1-dS)^2}{1+dR\,(1-dS)}$$

With this formula, the values for the cylinder for various ophthalmometric readings and spherical corrections were determined for a distance d of 13.75 mm. It can be seen that within the region of +2D to

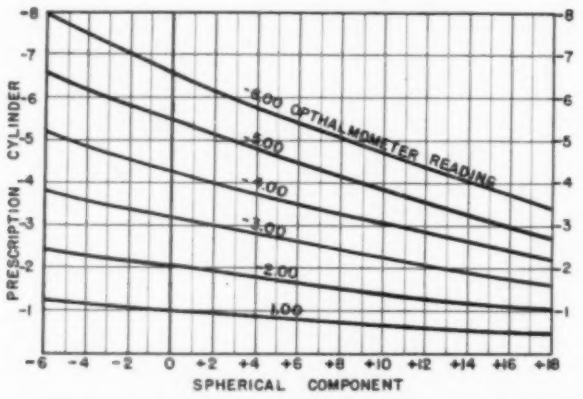
—2D of the spherical component, the changes in cylinder from the ophthalmometric reading are not significant, amounting to about .25D, Figure 22. They are, however, highly significant when applied to high spherical corrections such as found in aphakic eyes.

Another change of ophthalmometric readings may be mentioned here, although it is not induced by the position of the lens away from the eye. This change refers to the change of axis and power in cases of oblique corneal astigmatism, Figure 24. Here we find that the allowance for the so-called physiological astigmatism exerts an influence upon the cylinder found with the ophthalmometer causing a change in the axis as well as the power of the final correction cylinder, Figure 23. These two cylindrical components, namely, the physiological and the corneal astigmatism, must be combined as two obliquely crossed cylinders to find the final correction cylinder.

These two phases of the correction lens were discussed fully by Neumueller in the Bureau of Visual Science Bulletin No. 13 published by the American Optical Company.

EFFECT OF POWER AND POSITION OF THE CORRECTION LENS ON ACCOMMODATION, ADDITION AND PRESBYOPIA

The position of the correction cylinder 15 mm. in front of the primary principal plane of the eye also has an influence upon the accommodation, increasing the accommodation in hyperopia and decreasing it in myopia. We may define accommodation as the change in power necessary to compensate for the difference in vergence power of the rays from distant and near objects as incident upon the eye. The far-distant object will be imaged by the correction lens at the far point of the eye.



MODIFICATION OF THE OPHTHALMOMETER READING DUE TO THE POWER AND POSITION OF THE PRESCRIPTION LENS

Fig. 22.

RESULTANT CYLINDER or OPHTH. CYLINDER ⊂ PHYS. ALLOWANCE							
OPHTHALMOMETER READING −.25 AXIS				OPHTHALMOMETER READING −.50 AXIS			
OPH. AX.	PA−.25 AX. 90°	PA−.50 AX. 90°	PA−.75 AX. 90°	OPH. AX.	PA−.25 AX. 90°	PA−.50 AX. 90°	PA−.75 AX. 90°
0°	0	.25 AX. 90°	.50 AX. 90°	0°	.25 AX. 0°	0	.25 AX. 90°
15°	.13 AX. 52°	.30 AX. 77°	.55 AX. 83°	15°	.31 AX. 27°	.26 AX. 53°	.41 AX. 71°
30°	.25 AX. 60°	.43 AX. 73°	.67 AX. 81°	30°	.44 AX. 45°	.50 AX. 60°	.65 AX. 70°
45°	.36 AX. 68°	.56 AX. 76°	.79 AX. 81°	45°	.58 AX. 58°	.71 AX. 68°	.90 AX. 73°
60°	.44 AX. 75°	.67 AX. 80°	.90 AX. 83°	60°	.67 AX. 70°	.87 AX. 75°	1.05 AX. 79°
75°	.48 AX. 83°	.73 AX. 85°	.97 AX. 86°	75°	.72 AX. 80°	.96 AX. 83°	1.21 AX. 84°
90°	.50 AX. 90°	.75 AX. 90°	1.00 AX. 90°	90°	.75 AX. 90°	1.00 AX. 90°	1.25 AX. 90°
105°	.48 AX. 97°	.73 AX. 95°	.97 AX. 94°	105°	.72 AX. 100°	.96 AX. 97°	1.21 AX. 96°
120°	.44 AX. 105°	.67 AX. 100°	.90 AX. 97°	120°	.67 AX. 110°	.87 AX. 105°	1.05 AX. 101°
135°	.36 AX. 112°	.56 AX. 104°	.79 AX. 99°	135°	.58 AX. 122°	.71 AX. 112°	.90 AX. 107°
150°	.25 AX. 120°	.46 AX. 107°	.67 AX. 99°	150°	.44 AX. 135°	.50 AX. 120°	.65 AX. 110°
165°	.13 AX. 128°	.30 AX. 103°	.55 AX. 97°	165°	.31 AX. 153°	.26 AX. 127°	.41 AX. 109°
180°	0	.25 AX. 90°	.50 AX. 90°	180°	.25 AX. 180°	0	.25 AX. 90°
OPHTHALMOMETER READING −.75 AXIS				OPHTHALMOMETER READING −1.00 AXIS			
OPH. AX.	PA−.25 AX. 90°	PA−.50 AX. 90°	PA−.75 AX. 90°	OPH. AX.	PA−.25 AX. 90°	PA−.50 AX. 90°	PA−.75 AX. 90°
0°	.50 AX. 0°	.25 AX. 0°	0	0°	.75 AX. 0°	.50 AX. 0°	.25 AX. 0°
15°	.55 AX. 22°	.40 AX. 34°	.39 AX. 53°	15°	.79 AX. 20°	.63 AX. 27°	.52 AX. 39°
30°	.66 AX. 40°	.66 AX. 50°	.75 AX. 60°	30°	.90 AX. 37°	.87 AX. 45°	.86 AX. 54°
45°	.79 AX. 54°	.90 AX. 62°	1.06 AX. 68°	45°	1.03 AX. 52°	1.11 AX. 58°	1.25 AX. 64°
60°	.90 AX. 67°	1.09 AX. 72°	1.30 AX. 75°	60°	1.14 AX. 66°	1.32 AX. 70°	1.47 AX. 73°
75°	.98 AX. 79°	1.21 AX. 81°	1.45 AX. 83°	75°	1.22 AX. 78°	1.46 AX. 80°	1.69 AX. 82°
90°	1.00 AX. 90°	1.25 AX. 90°	1.50 AX. 90°	90°	1.25 AX. 90°	1.50 AX. 90°	1.75 AX. 90°
105°	.98 AX. 101°	1.21 AX. 99°	1.45 AX. 97°	105°	1.22 AX. 102°	1.46 AX. 100°	1.69 AX. 98°
120°	.90 AX. 113°	1.09 AX. 108°	1.30 AX. 105°	120°	1.14 AX. 114°	1.32 AX. 110°	1.47 AX. 107°
135°	.79 AX. 126°	.90 AX. 118°	1.06 AX. 112°	135°	1.03 AX. 128°	1.11 AX. 122°	1.25 AX. 118°
150°	.66 AX. 140°	.66 AX. 130°	.75 AX. 120°	150°	.90 AX. 143°	.87 AX. 135°	.86 AX. 126°
165°	.55 AX. 158°	.40 AX. 146°	.39 AX. 127°	165°	.79 AX. 160°	.63 AX. 153°	.52 AX. 141°
180°	.50 AX. 180°	.25 AX. 180°	0	180°	.75 AX. 180°	.50 AX. 180°	.25 AX. 180°
OPHTHALMOMETER READING −1.50 AXIS				OPHTHALMOMETER READING −2.00 AXIS			
OPH. AX.	PA−.25 AX. 90°	PA−.50 AX. 90°	PA−.75 AX. 90°	OPH. AX.	PA−.25 AX. 90°	PA−.50 AX. 90°	PA−.75 AX. 90°
0°	1.25 AX. 0°	1.00 AX. 0°	.75 AX. 0°	0°	1.75 AX. 0°	1.50 AX. 0°	1.25 AX. 0°
15°	1.29 AX. 18°	1.10 AX. 22°	.93 AX. 27°	15°	1.79 AX. 17°	1.60 AX. 20°	1.40 AX. 23°
30°	1.39 AX. 35°	1.33 AX. 40°	1.26 AX. 45°	30°	1.89 AX. 33°	1.80 AX. 37°	1.70 AX. 41°
45°	1.52 AX. 50°	1.58 AX. 54°	1.67 AX. 58°	45°	2.02 AX. 49°	2.06 AX. 52°	2.13 AX. 55°
60°	1.64 AX. 64°	1.81 AX. 67°	1.93 AX. 70°	60°	2.13 AX. 63°	2.29 AX. 66°	2.41 AX. 68°
75°	1.72 AX. 77°	1.95 AX. 79°	2.18 AX. 80°	75°	2.22 AX. 77°	2.44 AX. 78°	2.67 AX. 79°
90°	1.75 AX. 90°	2.00 AX. 90°	2.25 AX. 90°	90°	2.25 AX. 90°	2.50 AX. 90°	2.75 AX. 90°
105°	1.72 AX. 103°	1.95 AX. 101°	2.18 AX. 100°	105°	2.26 AX. 103°	2.44 AX. 102°	2.67 AX. 101°
120°	1.64 AX. 116°	1.81 AX. 113°	1.93 AX. 110°	120°	2.12 AX. 117°	2.29 AX. 114°	2.41 AX. 112°
135°	1.52 AX. 130°	1.58 AX. 126°	1.67 AX. 122°	135°	2.02 AX. 131°	2.06 AX. 128°	2.13 AX. 125°
150°	1.39 AX. 145°	1.33 AX. 140°	1.26 AX. 135°	150°	1.89 AX. 147°	1.80 AX. 143°	1.70 AX. 139°
165°	1.29 AX. 162°	1.10 AX. 158°	.93 AX. 153°	165°	1.79 AX. 163°	1.60 AX. 160°	1.40 AX. 157°
180°	1.25 AX. 180°	1.00 AX. 180°	.75 AX. 180°	180°	1.75 AX. 180°	1.50 AX. 180°	1.25 AX. 180°

TABLES GIVING CYLINDER POWER AND AXIS RESULTING FROM CORNEAL ASTIGMATISM OF VARYING AXIS AND POWER (−.25 TO 2.00 DIO.) AND PHYSIOLOGIC ALLOWANCE OF VARYING POWER (−.25 TO −.75 AX. 90). ALL CYLINDER POWERS ARE EXPRESSED IN MINUS QUANTITIES. THE VALUES IN THESE TABLES WERE DETERMINED BY GRAPHIC CONSTRUCTION

Fig. 23.

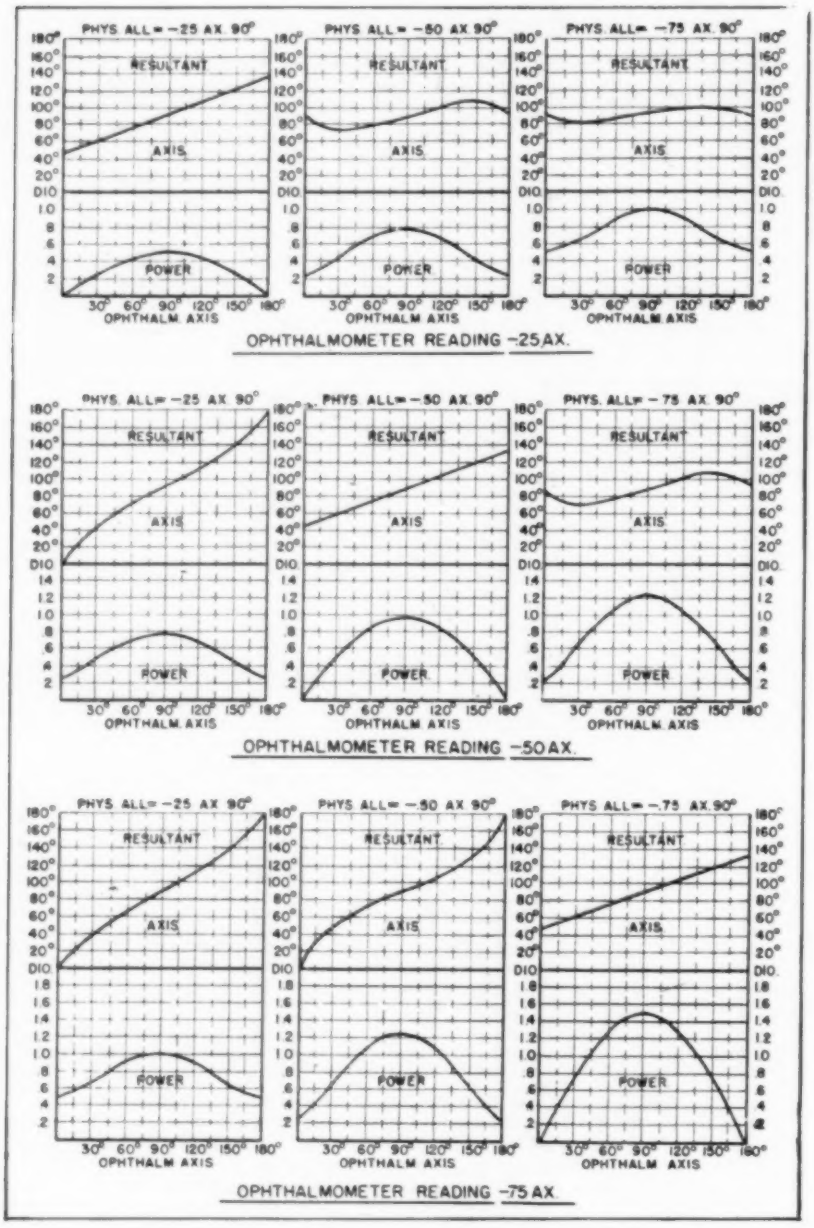

PHYS. ALL = −.25 AX. 90°
PHYS. ALL = −.50 AX. 90°
PHYS. ALL = −.75 AX. 90°
RESULTANT
AXIS
DIO.
POWER
30° 60° 90° 120° 150° 180°
OPHTHALM. AXIS
OPHTHALMOMETER READING −.25 AX.
OPHTHALMOMETER READING −.50 AX.
OPHTHALMOMETER READING −.75 AX.

Fig. 24.

An object 16″ in front of the lens may be imaged by a plus lens behind this far point. Accommodation must be applied by the eye to image this image of the near object at the far point. By determining the vergence of the distance rays and that of the near rays as incident upon the eye, we find the difference between these two vergences are:

$$A = \frac{R}{(1-dL)\,[dR-(1-dL)\,]}$$

where A is the accommodation

R = —2.5D is the reading distance.

L is the power of the correction lens.

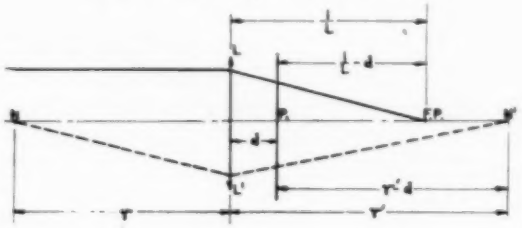
d is the distance from the correction lens to the primary principal plane of the eye.

Simplifying this equation by omitting members containing d in the second and higher order we finally arrive at:

$$A = -R\,(1+dR) - 2dRL$$

introducing the values for R = —2.50 and d = .015M, we find

$$A = 2.36 + .075\ L$$



VERGENCE OF DIST. RAYS $V_D = \frac{L}{1-dL}$;

VERGENCE OF NEAR RAYS INCIDENT UPON EYE $V_N = \frac{L}{1-d}$;

$-\frac{1}{f} + \frac{1}{f'} = L' = L + S$; $\frac{1}{f'} = R' = L + S + R$ $\left(R = \frac{1}{f}\right)$;

ACCOMMODATION $A = -(V_N - V_D)$

$A = \frac{L}{1-dL} - \frac{L+S+R}{1-d(L+S+R)}$;

SOLVING FOR $S = -R - A\,\frac{(1-dL)^2}{1-dA(1-dL)}$; (I)

SIMPLIFIED (I) $S = -R - A(1+dA) + 2\,dAL$ (II)

$S = C_1 + C_2 L$ ($C_1 = -R - A\,(1+dA)$; $C_2 = 2\,dA$)

SEGMENT ADDITION FOR PRESBYOPES

S = 0 IN EQUATION I.

$0 = -R - A\,\frac{(1-dL)^2}{1-dA(1-dL)}$

SOLVING FOR $A = \frac{R}{(1-dL)\,[dR-(1-dL)]}$ (III)

SIMPLIFIED $A = -R\,(1+dR) - 2\,dRL$ (IIIa)

FOR R = −2.50 DIO; d = 0.015 M.

$A = 2.36 + 0.075L$ (IIIa)

NEAR POINT ACCOMMODATION FOR NONPRESBYOPIC AMETROPES

Fig. 25.

Consideration of the last formula in Figure 25 shows that an increase of 1D in the power of the correction lens adds about .08D to the accommodation for 16″. The corrected hyperope needs more and the myope needs less accommodation for reading. Figure 26. This

fact immediately points out that the hyperope becomes presbyopic at an earlier age than the myope, assuming equal physiological accommodative deterioration. It also points to a difference in segment power for the two groups, Figure 27. The formula expressing the power of the segment, again omitting all members containing expressions of d of second and higher order, is:

$$S = -R - A(1+dA) + 2dAL$$

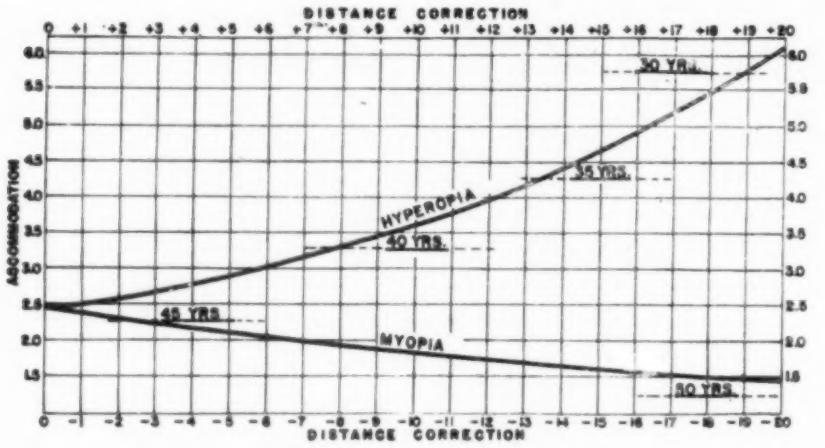
where S is the power of the segment

R — 2.50D is the reading distance.

A is the permissible accommodative power.

L is the power of the distance correction.

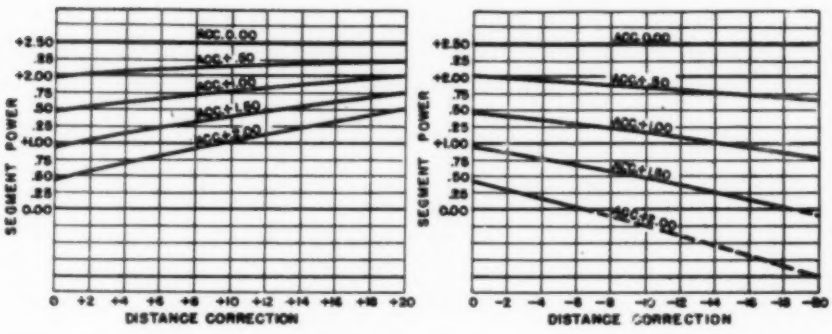
d is the distance from the correction lens to the primary principal plane of the eye.



ACCOMMODATION FOR CORRECTED NONPRESBYOPIC AMETROPES FOR 16" READING DISTANCE
RELATIVE APPROXIMATE AGE FOR BEGINNING OF PRESBYOPIA.

Fig. 26.

As a final deduction from the difference in accommodation induced by different degrees of ametropia, we must mention that high cylindrical corrections may have to be modified when used for reading. For example, a —4.00 axis 180° demands an accommodation of 2.5D in the 180° meridian and only 2.16D in the 90° meridian. To equalize the accommodative effort, we would have to increase the cylindrical power of the correction lens, using for near a —4.34D axis 180°. In a similar manner, it can be found that a +4.00 axis 180° used for distance should be modified to +4.30 axis 180° when used for reading.



PRESBYOPIC ADDITION FOR AMETROPES READING AT 16" USING ACCOMMODATION RANGING FROM 0.00 TO 2.00D

Fig. 27.

PRISMATIC EFFECT OF SINGLE VISION LENSES

Any ray, except that passing through the optical center of the lens, is deviated. That means at any point other than the optical center the lens acts like a prism, Figure 28. For a spherical lens, the prismatic power is equal to the product of the lens power and the distance in centimeters from the optical center to the point under consideration. The direction of the prism is in the line from the optical center for a plus lens and away from it for a minus lens.

$$P = Dd$$

Where P is the prismatic power in prism diopters

D is the dioptric power of the spherical lens.

d (cm) is the distance from its optical center to the point of regard.

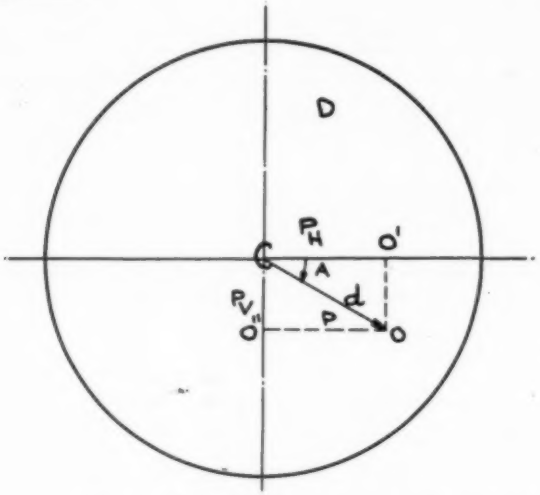
By solving this equation for d one can find the amount of decentration necessary to give a desired amount of prismatic effect so that

$$d\,(cm) = \frac{P}{D}$$

If desired, this prism can be resolved into a horizontal and vertical component treating it in vector fashion. Drawing the prism to a known scale and in its true direction from the center of the lens and letting fall the perpendiculars on to the vertical and horizontal meridians gives the horizontal and vertical components of the prism.

A cylindrical lens has a prismatic effect at any point off its axis, Figure 29. The prismatic effect is active only in the direction of the power of the cylinder and is found by multiplying the dioptric power of the cylinder by the distance in centimeters of the point from the axis.

For an oblique cylinder the prismatic effect is oblique and at right angles to the axis. Again, this effect can be resolved into a horizontal and vertical component.



$P^{\Delta} = D\,d\,[cm]$; $P_H = P \cos. A$; $P_V = P \sin. A$

PRISMATIC EFFECT AT POINT D OF A SPHERE

Fig. 28.

$VERT^{\Delta} = NP\,[cm] \cdot D$; $HOR^{\Delta} = MP\,[cm] \cdot D$

PRISMATIC EFFECT AT POINT A OF A CYLINDER

Fig. 29.

In case of a sphero-cylinder it is best to find the sums of the horizontal and vertical components due to the sphere and the cylinder. If so desired, the resultant of these two components can then be determined either graphically by vector methods or by computation.

PRISMATIC EFFECT OF BIFOCAL LENSES

While bifocals have not yet been discussed, this seems to be the proper place for the discussion of their prismatic effect. For a detailed study of this subject we refer to the book by Dr. P. Boeder, "Analysis of Prismatic Effects in Bifocals," published by The Bureau of Visual Science of the American Optical Company.

For theoretical consideration, it is best to assume any bifocal to consist of a complete distance lens and a separate complete cement-wafer representing the segment. This concept is applicable to all and any kind of bifocal lenses.

Three centers can then be distinguished, Figure 30, namely: the center of the distance portion, the center of the segment proper, and the optical center of the reading portion which is the point at which the prismatic effect induced by the segment neutralizes the prismatic effect caused by the distance portion. A ray passing through this last mentioned center will suffer no deviation. Or, one may say, the object observed through this last mentioned center will suffer no displacement

The following condition obtains for this point:

$$a = \frac{Ad}{A+D}$$

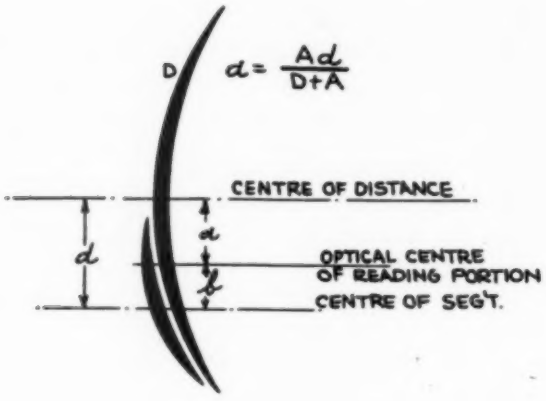
Where a is the distance between the optical centers of the distance and the reading portion of the lens

A is the dioptric power of the segment only.

D is the dioptric power of the distance portion.

d is the distance between the center of the distance position and that of the segment.

It is evident in Figure 30, that the greater the distance d between the centers of the segment and the distance lens, the greater will be the displacement of the optical center of the reading portion. The closer the center of the segment is to the center of the distance lens, as in Ful-Vue or Univis, the less is this displacement and, for the same reason, the Ultex A has the largest displacement. On this relationship is based the design of the bifocal selection cards published by the American Optical Company and the Bausch & Lomb Company.

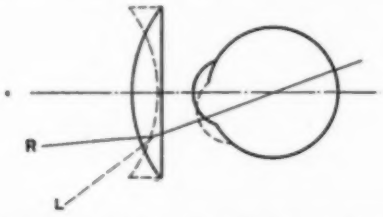


LOCATION OF OPTICAL CENTRE OF READING PORTION

Fig. 30.

PRISMATIC EFFECT IN ANISOMETROPIC CORRECTIONS

Looking through the segment of a bifocal will not introduce an intolerable phoria as long as the dioptric powers in the vertical meridians of the right and left lens do not differ too much. In anisometropic correction these discrepancies may reach intolerable dimensions, Figure 31. The lateral prismatic discrepancies are usually disregarded, assuming the lateral ductions to be high enough to overcome them. The vertical ductions being considerably smaller, may not be able to overcome the prismatic effect when looking through the periphery of the lenses. For such cases the use of "slab-off" prisms is recommended.

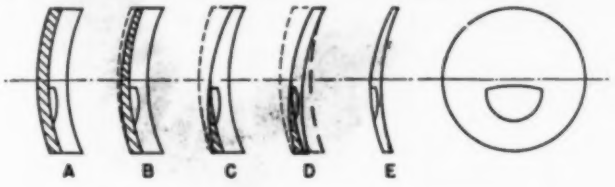


ANISOMETROPIA CAUSES ANISOPHORIA IN PERIPHERY OF LENS

Fig. 31.

In order to produce a "slab-off" prism, Figure 32, the anterior surface of the bifocal lens is finished as usual. A slab is then cemented on to it and a prism, base down, is ground on to this blank. The power of the prism to be ground is determined by the prismatic discrepancies in the vertical meridians of the two lenses. The grinding of the outside surface is continued until the boundary line of the slab almost touches

the top of the bifocal segment. Without removing the dummy, the blank is now turned and the lens finished in the conventional manner without any prism. When the dummy is removed, the lens carries a prism "base up" on the lower half of the lens. It is the writer's opinion that "slab-off" prisms should be used with discretion—only in extreme cases and after repeated tests have proven their necessity.



BASE UP "SLAB OFF" PRISM ON BIFOCAL

Fig. 32.

[Part three of this paper will appear in the August issue.]

ABSTRACTS

THE INCIDENCE OF CONVERGENCE INSUFFICIENCY IN THYROID CASES. J. A. Lampard. Canadian Journal of Optometry. December. 711-713. 1947.

The author conducts his practice in what he calls the "goitre belt of the Rocky Mountain range." (Alberta and British Columbia, Canada.)

Hyperthyroidism is frequently associated with convergence insufficiency, claims Lampard, and cites the findings of Mobius as well as his own clinical studies of the subject. He believes that from seven to eight per cent of his patients have thyroid disturbances and that 67 per cent of these are troubled with some near-point convergence problem.

Convergence insufficiency should be part of the diagnostic syndrome in goitre cases, the author believes. He also claims that orthoptics are of little value in these cases but that prisms do give relief until the case is given medical attention. The prisms prescribed by Lampard vary from 1△ to 4△ base-in.

C. C. K.

VISION AND FATIGUE. O. McK. Ferguson. Optics. (Glasgow, Scotland.) No. 56. August. pp. 3-5. 1947.

The author reviews the well-known work of Luckiesh and Moss in the field of illumination and visual fatigue and points out that the attainment of comfortable binocular vision is not simply a matter of correcting refractive errors. He claims our present techniques are quite adequate as far as this is concerned but believes the future requires that the work of the optometrist must be correlated with other branches of knowledge if the greatest service is to be rendered the public.

V. H.

THE VALUE OF OPHTHALMIC LENS COATING. E. B. Brown. Optical Journal and Review of Optometry. 84. 18. 41-46. 1947.

According to the author, the methods used in present-day lens coating produce an effect two to four times more permanent than did the process in use several years ago. The author believes that lens coating is most essential in strong corrections and needed in all prescriptions. He reviews the technique of present-day lens coating and points out that as the demand for this service increases the cost will decline.

C. C. K.

INVESTIGATION OF THE VARIATION AND THE CORRELATION OF THE OPTICAL ELEMENTS OF HUMAN EYES* §

Solve Stenstrom†
Med. lic., Gbg.
Translated by Daniel Woolf ‡
Columbia University Optometry Laboratory
New York, New York

PART III — CHAPTER III

ANALYSIS OF MATERIAL[25]

As stated in previous discussion, the material used in this investigation cannot be regarded as completely representative. On one hand it contains a significantly higher percentage of males than females; on the other, the refractive error distribution does not fully agree with that expected for the total adult population. The following table (Table 11) compares the material used here with Stromberg's, after conversion to principal point refraction.

Our material has a significantly larger proportion of refractive anomalies than Stromberg's, especially for females. The low percentage of ametropia in the latter group can be accounted for by the fact that the refractive determination could hardly be fully effective under the conditions prevailing or inherent in the examination. In addition, the grouping of material is such that the absolute distribution of a single element cannot be determined. Nevertheless, I proceeded in the following manner in order to obtain a concept of the distribution. Earlier studies (Steiger, Rosengren, and others) have convinced me that the refracting power of the cornea and the depth of the anterior chamber are normally distributed. If the distribution of these elements in this material is found to be normal, then so must the other elements show a normal distribution if their totality is normally distributed; and if the distribution of one or another of the elements is found to deviate significantly from the normal, it can be concluded with good probability that it does not stem from a normally distributed totality.

---

†From the Ophthalmological Clinic of the University of Upsala. Professor Frederick Berg, Chief.

‡Optometrist. Fellow, American Academy of Optometry.

*UPSALA 1946. Appelbergs Boktryckeri A.-B.

§The third of six chapters. The fourth will appear in the August issue.

25. With regard to the statistical methods used here, the reader is referred to the textbooks on statistics listed in the bibliography.

Table 11

	−8.0	−8.0 to −7.0	−7.0 to −6.0	−6.0 to −5.0	−5.0 to −4.0	−4.0 to −3.0	−3.0 to −2.0	−2.0 to −1.0	−1.0 to ±0	±0 to +1.0	+1.0 to +2.0	+2.0 to +3.0	+3.0 to +4.0	+4.0 to +5.0	+5.0 to +6.0	+6.0 to +7.0	+7.0 & greater
Stromberg's Material.....	0.1	0.2	0.2	0.3	0.3	0.7	1.1	1.9	4.1	64.9	23.8	1.6	0.3	0.2	0.2	0.1	0.1
Material* Females.....	1.6	1.0	1.6	2.5	2.9	3.2	5.1	4.8	11.4	46.3	14.6	1.3	0.3	1.3	0.9	0	1.3
Males.....	0.7	0.3	0	0.3	1.6	2.2	2.7	5.3	11.5	56.9	12.6	2.0	1.0	0.6	0.7	0.7	0.9
Combined Material.....%	1.0	0.5	0.5	1.0	2.0	2.5	3.4	5.1	11.5	53.6	13.2	1.8	0.8	0.8	0.8	0.5	1.0

*Material by Stenstrom.

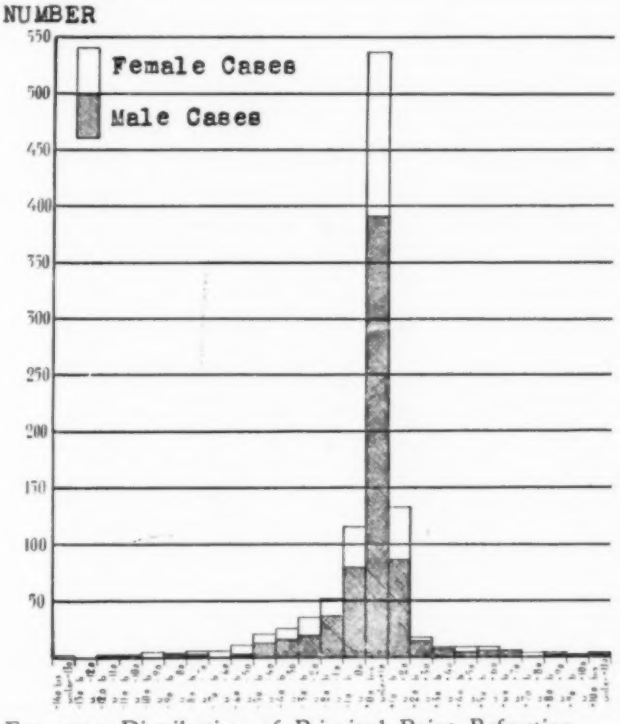


Fig. 5—Frequency Distribution of Principal Point Refraction.

Before we go further into the problem, the distribution of material with respect to refractive error should be closely scrutinized. It is shown

in Figure 5. As can be seen, the distribution has comparable characteristics to those shown in the distribution of the total population, namely a strong kurtosis, and a definite skewness.[26] The mean refractive error for the combined sample is $+0.12 \pm 0.070$ D [27] and the standard deviation is $\pm 2.20 \pm 0.049$ D. The corresponding value for males is $M = +0.29 \pm 0.075$ D, and $\sigma = \pm 1.95 \pm 0.053$ D; for females $M = -0.27 \pm 0.147$ D and $\sigma = \pm 2.62 \pm 0.104$ D. The difference between the means of the two sexes is 0.56 ± 0.165 D and between the standard deviations, 0.66 ± 0.117 D. The groups are not analogous; that for the females contains relatively more ametropia and above all more myopia than that of the males. This difference must be considered when as in the following discussion, certain sex differences are to be evaluated. As will be shown, this sex difference is relatively insignificant so that for certain researches it would be most suitable to treat the sample as a unit and thereby obtain increased information. Skewness and excess were not calculated for the refractive error distribution, but they were calculated on the more representative sample of Stromberg (see Table 5).

A. THE VARIATION OF THE INDIVIDUAL ELEMENTS

We shall now consider *the general character of the various optical elements* more closely. For the reasons given above I have used the total sample without division into sexes. The χ^2 test was used to compare the distribution of this material with a normal distribution. It was necessary to combine the extreme cases so that no group contained fewer than five individuals.

The values obtained are found in the following table.

TABLE 12

Element	No. of Classes	Degrees of Freedom	Computation $\left\{ \frac{\chi^2}{m} \right\}$	Highest Value Allowed*
Corneal Radius (ρ)	15	12	1.522	2.508
Depth Ant. Chamber (d)	16	13	0.542	2.435
Axial Length (b_1)	12	9	11.951	2.807
Corneal Ref. Power (D_1)	15	12	1.910	2.508
Lens Ref. Power (D)	16	13	1.517	2.435
Total Ref. Power (D_2)	19	16	1.326	2.264

*Probability exceeding 0.0027 (Koller's Value).

26. The refractive error curve is depicted with its negative part to the left, in accordance with the custom of analytic geometry. For unintelligible reasons, the myopic portion is often placed on the right in ophthalmological literature (Scheerer, Betsch, and others).

27. This value is based on the principal point refraction (axial refraction), which explains the nearly symmetrical limits. In comparing it to other papers, the effect of the 10 meter refracting distance should be taken into consideration. This value is about 0.1D less than that usually given where the testing distance is five meters.

As previously discussed, it is known that the depth of the anterior chamber and the corneal refracting power are normally distributed. As is evident from the table, the χ^2 value of these factors lies within allowable limits. Accordingly, we may consider our material to be a random sample of a normal distribution. In addition, Table 12 shows that *the distribution of lens refracting power, total refracting power and corneal radius may also be considered as samples taken at random from a normal distribution.*[28]

Some earlier authors have pointed out that the corneal radius cannot be normally distributed when the corneal refracting power displays this type of distribution. The deviation from the normal distribution is insignificant because of the small sample, and becomes masked by a chance sampling error.

The χ^2 value for the axial length is essentially above that allowed. Therefore the deviation from the normal curve cannot be ascribed to chance; *the distribution shows a very significant deviation from the normal.*

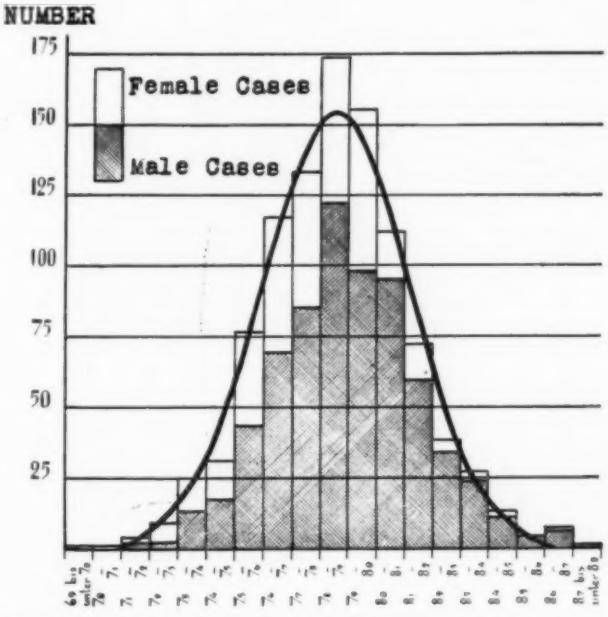


Fig. 6—Frequency Curve of the Corneal Radius.*

*The inscribed normal distribution curves in Figures 6, 7, 8, 10, 11 and 12 are drawn to represent the combined sample.

28. When the χ^2 test shows that a sample could have been obtained from a normal distribution, it is senseless to search for a more significant explanation. Fischer says, "Departures from normal form, unless very strongly so, can only be detected in large samples." Dahlberg figured skewness out of 64 cases.

We have discussed the manner in which the elements vary generally, and we now shall consider the behavior of the individual elements in detail. Only then will we examine those differences associated with sex.

1. THE DISTRIBUTION OF THE CORNEAL RADIUS (Figure 6).

The mean value for the entire sample is 7.86 ±0.008 mm. and the standard deviation, ±0.259 ±0.0058 mm. The range of variation extends from 7.00 to 8.65 mm.

The results of earlier works are considered under Corneal Refracting Power.

2. THE DISTRIBUTION OF THE DEPTH OF THE ANTERIOR CHAMBER (Figure 7).

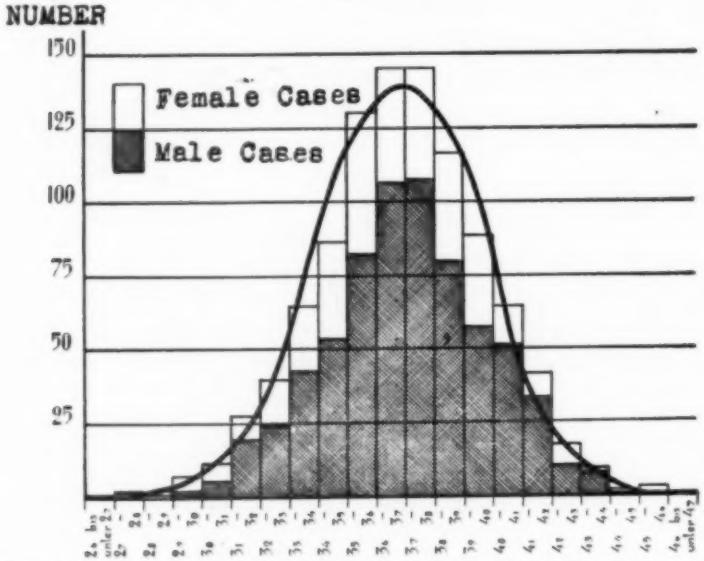


Fig. 7—Distribution Curve for the Depth of the Anterior Chamber.

The mean obtained from the entire sample is 3.68 ±0.009 mm., and the standard deviation is ±0.287 ±0.006 mm. The values ranged from 2.80 to 4.55 mm.

The values found are in good agreement with those obtained by earlier workers. One hundred and four cases (aged 20 to 40) of Raeder show M = 3.58 ± 0.03 mm. and $\sigma = \pm 0.31 \pm 0.02$ mm.[29]

Rosengren's corrected mean cannot be used for comparison because it was obtained from subjects of a different age group. However, his standard deviation is in good agreement with mine.

3. THE DISTRIBUTION OF THE AXIAL LENGTH (Figure 8).

The length of the visual axis is, as already stated, the only element

29. Raeder's values were corrected according to his directions.

whose distribution shows a demonstrable and definite deviation from the normal. Accordingly, the calculation of skewness and kurtosis is indicated. These values are found in the following table.

TABLE 13. CHARACTERISTICS OF THE AXIAL LENGTH DISTRIBUTION

	Mean	σ	γ_1 [30]	γ_2 [30]
♂	24.04 ± 0.038	±1.00±0.027	+0.47±0.094	+3.69±0.187
♀	23.89 ± 0.071	±1.27±0.050	+1.26±0.138	+2.89±0.276
Both	24.00 ± 0.035	±1.09±0.024	+0.81±0.077	+3.35±0.154

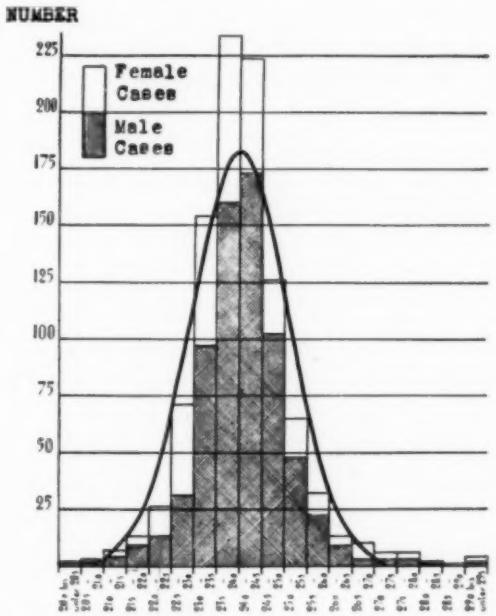


Fig. 8—Distribution Curve of the Axial Length.

It is evident from the table that the frequency distribution of the entire sample as well as that for each sex shows a pronounced skewness and a strong kurtosis. The range was found to lie between 20.0 and 29.5 mm. However, it should be noted that no cases of genuinely high

$$^{30}\gamma_1 = \sqrt{\frac{\mu_3^2}{\mu_2^3}} \text{ and } \gamma_2 = \frac{\mu_4 - 3\mu_2^2}{\mu_2^2}$$

where μ_2 is the spread and μ_3 and μ_4 are the third and fourth moment of the mean (Pearson cited by Yule-Kendall). Skewness, after Charlier, $S = \frac{1}{2}\gamma_1$ and kurtosis $E = \frac{\gamma_2}{8}$. Sheppard's correction was made.

myopia were included.[31] Undoubtedly, these rare cases are purely pathological in origin (and often accompanied by other deformities—for example, Marfand's Syndrome) and should not be considered in a study such as this.

The cause of the skewness and kurtosis is generally sought in a lack of homogeneity of the selected sample. Only to an insignificant degree can the skewness and kurtosis of the total group be attributed to dissimilar properties of the male and female subjects, because both groups display equally distinct departures from a normal distribution.

In conformity we must accept the conclusion that the distribution curve of the axial length, disregarding the sex difference, arises from the addition of two or more types of subjects with different properties. It is difficult to arrive at the cause of this heterogeneity. Tron's (a) attempt (by eliminating cases of myopia over 6D) is entirely arbitrary and can hardly lead to a clarification of the question. Scheerer and Betsch rest on firmer footing when they form a special pathological group out of all eyes with myopic fundus changes, including conus. By excepting these cases they obtain a symmetrical curve for the remainder, which, as Wibaut (b) has demonstrated, still shows a strong kurtosis. As a result of their investigations, Scheerer and Betsch concluded that the distribution of the axial length for conus-free eyes is symmetrical. After exclusion of all eyes with the fundus changes considered here (conus temporalis, conus inferior with more obvious myopic changes), our distribution curve is not only symmetrical, but in addition shows very good agreement with the normal distribution curve (Figure 9). The $\frac{x^2}{m}$ value is 4.766 for 7 degrees of freedom, as against an allowed maximum of 3.121, $\gamma_1 = -0.19 \pm 0.083$, and $\gamma_2 = \pm 1.54 \pm 0.166$. There remains only a moderate kurtosis.

As a group, eyes with an axial length of over 27.5 mm contain conus formations; while in eyes under 22.0 mm, no cases of conus were met.

Earlier measurements of the overall length of enucleated eyes agree in order of magnitude with the values obtained here.

31. I had the opportunity of measuring the axial length in a case of —23.5 D principal point refraction. The optical elements were $\rho = 7.39$ mm, $d = 3.77$ mm, $b_1 = 31.9$ mm, $D_1 = 45.47$ D, $D_2 = 24.74$ D, and $D = 67.04$ D. Myopic appearance of the fundus.

Since the visual acuity of the case was too low to allow for refraction by Donders' method (the above value was determined by skiascopy under cycloplegic), it was not included in the statistical treatment. As can be seen the axial length lies beyond the range of values of the normal distribution.

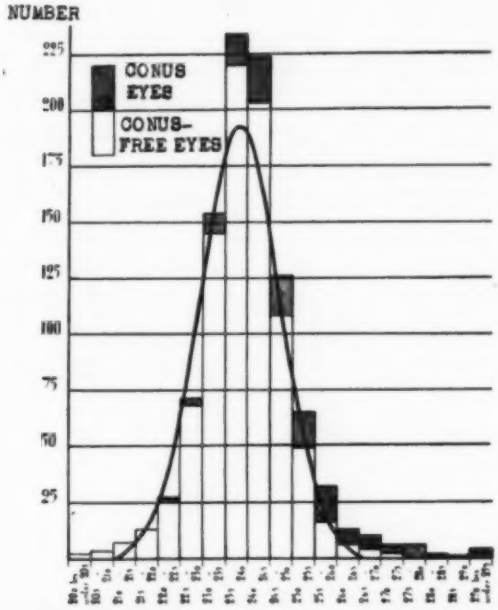


Fig. 9. Distribution of Axial Length with Indication of Conus Frequency. The curve drawn in represents the conus free eyes.

In 1936 Erggelet and Geserick made a somewhat more comprehensive study of the axial length on post-mortem eyes. They measured 122 eyes of unknown refractive error. Their distribution was nearly symmetrical, had a slightly higher apex and barely departed from a binomial distribution. The mean was 24.68 $\pm$ 0.089 and σ = $\pm$ 0.988.

Tron (e) found a variation of the axial length from about 20.5 to 46 mm.

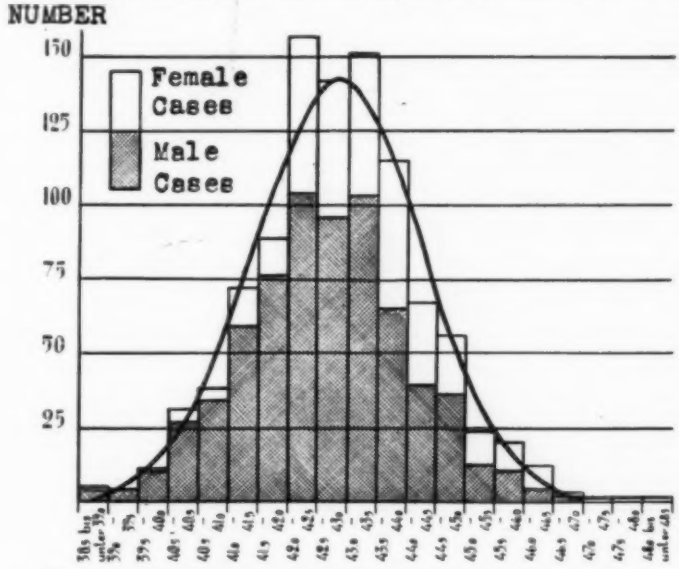


Fig. 10. Distribution of the Corneal Refracting Power.

4. THE DISTRIBUTION OF THE CORNEAL REFRACTING POWER (FIGURE 10).

For all subjects, the mean is 42.84 ± 0.044 D, and the standard deviation is ± 1.401 ± 0.0313. The range is from 38.5 to 47.0 D.

The mean and the range show good agreement with values published in earlier papers.

5. DISTRIBUTION OF THE REFRACTING POWER OF THE LENS (FIGURE 11).

Before we consider the variation of the refracting power of the lens it must be emphasized that the measure used is the *anterior vertex refracting power* and that this is about 3 D less than the corresponding principal point refracting power. This is to be borne in mind in making comparisons with other work.

The characteristics obtained for all subjects are: Mean = 17.35 ± 0.044 D, σ = ± 1.480 ± 0.031 D, range of distribution from about 12.5 to 22.0 D.

This investigation confirms Tron's contention that the variation of the refracting power of the lens is at least as large as that of the cornea. The proportionately large error in determination of the refracting power of the lens raises slightly the value obtained for the standard deviation, which might actually lie under the value found. As stated, no more extensive investigation of the variation in the power of the lens has been made. Tron's (2a) material, it is true, contained 200 eyes. When corrected for the faulty computation of the refracting power of the lens, Tron's mean value was 19.5 ± 0.14 D, with a standard deviation of ± 2.0 ± 0.10 D.[32]

Comparison of this value with that obtained for the vertex refracting power here discloses a satisfactory similarity between the mean values. We must not lose sight of the fact that Tron's work is affected by errors which are relatively large and difficult to estimate (Zeeman), which can fully explain the proportionately large difference between the standard deviations.

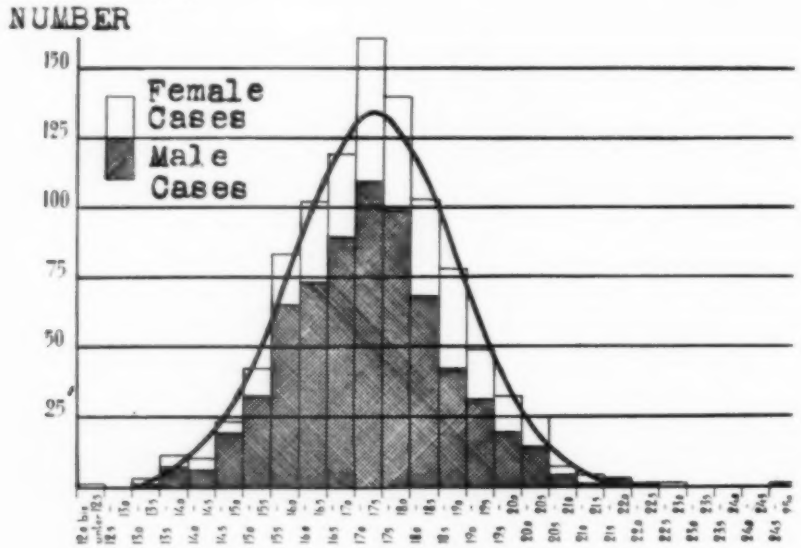


Fig. 11. Distribution of the Refracting Power of the Lens.

32. Tron's original values are M = 25.99 ± 0.18 D. and σ = ± 2.61 ± 0.13.

6. THE DISTRIBUTION OF THE TOTAL REFRACTING POWER (FIGURE 12).

In viewing the total refracting power, one should remain aware that the value stated here is about 1.5 D less than values obtained when the refracting power has been computed from the optical center of the lens.

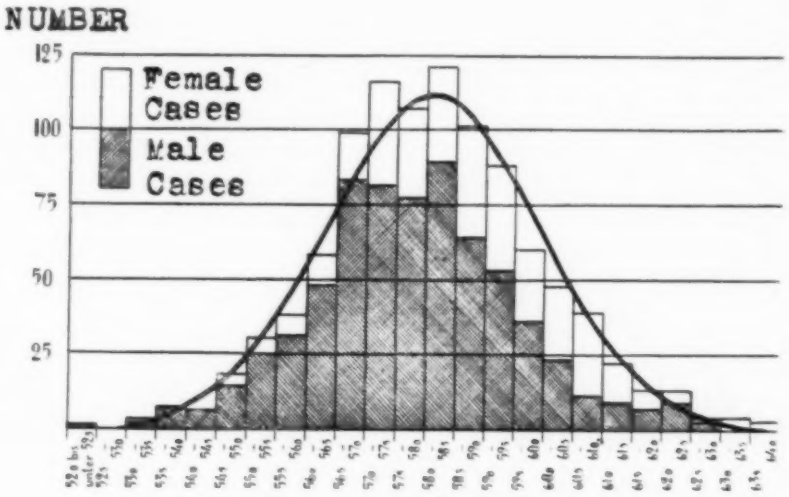


Fig. 12—Distribution of the Total Refracting Power.

The mean value for all subjects is 58.13 ± 0.056 D and the standard deviation ± 1.78 ± 0.040 D. The range is from 52.5 to 63.5 D.

As already mentioned, no reliable study of the variation in total refracting power has as yet been made. On Tron's material, we computed the mean of the total refracting power using the mean for the cornea (43.55 D) and the corrected mean for the lens (19.54 D) and considering the optical center of the lens to lie at a distance of 5.54 mm from the corneal vertex. The value obtained thereby was 59.5 D. which is in excellent agreement with my findings.

We arrive at the question of a sex difference. As shown in Table 14, the linear measures—corneal radius, depth of chamber and axial length—of females are smaller than those of males; while the refracting powers of the latter are somewhat lower. The differences vary from two to eight times their mean errors and amount to about 1.5 per cent of the male mean values. (1.3 per cent for the depth of the chamber, 1.8 per cent for the power of the lens, and 1.6 per cent for the rest.) Thus a difference undoubtedly exists, and is of value only for the purpose of deciding whether its basis lies in the dissimilar distribution curves of refractive errors for the male and female subjects of this paper, or whether it is an expression of a genuine sex difference. As stated, the female subjects contain a greater proportion of myopes than the male:

but because a negative correlation exists between refraction on one hand, and axial length and depth of the chamber on the other, the female eyes should show a higher value for the latter measurements. Since a weak positive correlation exists between the corneal radius and refractive error it is expected that the mean corneal radius for females will be somewhat lower than for males. However, this correlation does not explain the pronounced difference (about eight times its mean error). Nevertheless, we can conclude that on the average, female eyes are somewhat smaller than male, and that this difference is not significant since it is only about 1.5 per cent of the mean male value. The refracting power is, as mentioned, somewhat larger for the same reason. The refracting power of the lens shows no correlation with refractive error so that the difference here cannot be based upon the unequal character of the subjects.

TABLE 14

Element	Mean ($M \pm \epsilon_M$) ♂	Mean ($M \pm \epsilon_M$) ♀	S. D. ($\sigma \pm \epsilon_\sigma$) ♂	S. D. ($\sigma \pm \epsilon_\sigma$) ♀	Diff ($M_♂ - M_♀$) $\pm \epsilon$ Diff M	Diff ($M_♂ - M_♀$) $\pm \epsilon$ Diff σ
P	7.90±0.010	7.77±0.014	0.256±0.007	0.242±0.010	0.13±0.017	0.014±0.012
d	3.70±0.011	3.65±0.017	0.281±0.008	0.294±0.012	0.05±0.020	−0.013±0.014
b_1	24.04±0.038	23.89±0.071	1.001±0.027	1.262±0.050	0.16±0.081	−0.261±0.057
D_1	42.62±0.052	43.31±0.076	1.371±0.037	1.348±0.054	−0.69±0.091	0.023±0.065
D_2	17.25±0.055	17.56±0.086	1.435±0.039	1.532±0.061	−0.31±0.102	−0.097±0.073
D	57.82±0.065	58.73±0.102	1.691±0.046	1.814±0.072	−0.91±0.121	−0.123±0.086

Note: The underlined differences are those which are more than three times their error of the mean.

The axial length is the only element whose standard deviation shows a noticeable sex difference for these subjects. Since axial length and refractive error are strongly correlated, the increased standard deviation of the female group could depend entirely on its greater spread in refractive error distribution. There is no reason to expect a greater variability in females in this respect. The greater skewness and diminished kurtosis of the female group can have the same basis. As already stated, Donders, and later Steiger, have shown that the mean corneal refracting power is larger in women.

Steiger's material (cited by Barrington and Pearson) shows the following values. For males of all ages $M = 42.56 \pm 0.035$ D.[33] $\sigma = \pm 1.291$ D. For females of all ages $M = 42.97 \pm 0.032$ D.[33] $\sigma = \pm 1.293$ D. The difference 0.41 ± 0.047 is therefore reliable. Possibly the reason for Steiger's value being lower than mine is racial difference. Another possibility may be a different spacing or the ophthalmometer. (Steiger does not give the calibration of his apparatus).

Paul measured 1.002 male and 1.334 female eyes. He found that the mean corneal radius of the male was 1.7 per cent longer than the female value, which is in good agreement with my value.

33. Value corrected for n = 1.336.

[Part Four of this paper will appear in the August issue]

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 25 JULY, 1948 No. 7

EDITORS AND STAFF

Dr. Carel C. Koch ..... *Editor*
Dr. Robert E. Bannon ..... *Research Editor*
Virginia Huck ..... *Editorial Assistant*
Joseph G. Majersky ..... *Editorial Assistant*
Harry Brookins ..... *Production Manager*
William H. O'Brien ..... *Advertising Manager*
Mary L. Kerr ..... *Circulation Manager*

Publication and Academy Office: 1502 Foshay Tower, 821 Marquette Ave. Minneapolis 2, Minnesota

Annual Subscription, $5.00 in Advance; Canada, $5.50; Foreign, $6.00; Single Copies, 50c.

Original papers, scientific communications, clinical reports, books for review, and correspondence should be sent to the editor. Subscriptions and applications for single copies should be addressed to the circulation manager. Copy of advertisements must be sent in by the first of the month preceding their appearance. Communications with reference to advertising or other journal business should be addressed to the advertising manager. Academy correspondence should be addressed to Dr. Carel C. Koch, Secretary, of the American Academy of Optometry.

Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

The American Academy of Optometry and the publishers of this journal have no objection to the reprinting by other magazines of any of the articles in this issue, provided such reprints are properly credited to the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

BRITISH SOCIALIZED HEALTH PROGRAM

An experimental health program which will have far reaching effect on optometrists as well as other health workers was launched July 5, in England. Under the leadership of a socialistic government, the public is being offered a complete health service. The plan includes all medical, surgical, optical, nursing and dental care. While not compulsory for the doctor, the plan is entirely tax supported and its proponents claim that it will supply health services to many thousands who heretofore were unable to obtain them through the usual private sources.

At the start, physicians, optometrists and dentists will do the required professional work in their offices. The plan provides for numerous large clinics and as these are established the doctors who participate

in the program are expected to devote a major portion of their time to service in the government health centers.

Since the program's conception, the optometric organizations of England have given it some support. This has not been true of organized medicine, where the idea has been officially viewed with much skepticism.

Recent reports indicate, however, that medicine, dentistry and optometry have accepted the inevitable and are now at work to make the best of the plan and to preserve as much as possible of their professional freedom and identity under the broad canopy of government regulation.

The plan, which is subject to change, includes all citizens and all health services. Employed persons contribute fixed weekly sums as their benefit payments. Self-employed persons pay similar fees directly to the government. The amount of payment is determined by the number of persons covered. All persons must pay these fees into the program.

The health work will be done by doctors who enroll on official panels which in turn will be supervised by professional and lay committees.

It is now planned that all of the work will eventually be done at clinics or health centers which will function under the administrative supervision of local boards appointed by the government.

Present indications are that in the early part of the program, while the government health work is being done in private offices, doctors will receive fixed fees from the government for services rendered patients. Later, while working in the clinics, they will serve on a salary basis.

In this program optometrists will be compensated only for professional services. Practitioners will be allowed no profit on the materials they dispense under the program. Government regulations stipulate the type and quality of the ophthalmic materials to be used. Regulations also set the fees to be paid optometrists for these materials.

British optometrists anticipate that government regulations will permit patients to pay them extra fees for ophthalmic luxury items not included on government schedules.

Patients still have the right to select the optometrist of their choice providing his name appears on the approved panel. However, they must first clear their request through their panel physician.

Anybody may elect to ignore the program entirely and select his optometrist on the fee basis as of old.

Today the attention of all health workers is fixed on this English public health experiment. The transition from private to public practice on a larger scale than ever before attempted is sure to have some repercussions. American optometrists, while unable to visualize themselves bound by such regulations, wish their British cousins nothing but success on the uncharted course before them.

CAREL C. KOCH

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ACADEMY GRANTS $3,500 FOR VISUAL RESEARCH

Grants-in-aid totaling $3,500.00 for visual research were approved this month by the American Academy of Optometry. Upon recommendation of the Research Projects committee of the Academy the School of Optometry at Ohio State University was granted $1,500.00 and Columbia University's Optometry Laboratory, $2,000.00.

Ohio State will use the money to continue a project carried on during the past academic year in which an investigation was made of the effect of low levels of illumination and freedom from optical stimulation of accommodation upon the refractive state of the eye. The second part of the investigation (to be completed during the 1948-49 school year) will determine the role played by varying levels of illumination.

It has been known for some time that low levels of illumination produce what seems to be a change in the refractive status of the eye similar to a decrease in hyperopia or an increase in myopia; hence, the term, "nocturnal myopia." The Ohio State investigation should determine whether the visual experience in low levels of illumination is due to an actual refractive change or to other factors. The project will be under the direction of Dr. Glenn Fry of the School of Optometry.

The $2,000.00 granted Columbia's Optometry Laboratory will be used by two Columbia graduates to help finance an investigation of certain aspects of the Pulfrich Phenomena. The graduates, Dr. Aaron Hyman and Dr. Frederick Lit, plan to begin an investigation of binocular vision and space perception by studying the visual latent period as measured by the Pulfrich stereo-phenomenon. Some of the variables which conceivably affect the visual latent period are velocity and

amplitude of stimulus movement; the effect of observation distance; the width or area of the moving stimulus, and the wave length of light. It is planned to correlate the results of one (or more) of these variables with the known facts relating to the photo-chemical theory of retinal action and the laws of binocular projection. The results of this study, besides providing new information regarding the fundamental nature of the visual processes, may have a direct clinical application in contributing to our understanding of faulty binocular space perception.

Dr. Lit is a Columbia graduate in optometry and obtained his Ph.D. this year in psychology at Columbia. He has accepted a full time position as a member of the optometry faculty at Columbia. Dr. Hyman, a recent graduate in optometry at Columbia, will assist Dr. Lit. The investigation will be supervised by Dr. Clifford L. Treleaven of the Optometry Laboratory.

ROBERT E. BANNON

CONVENTION NOTES

Heads are getting together from California to New York to make the 1948 annual convention of the Academy at Winston-Salem, North Carolina the best in history. Hotel arrangements have been completed and Dr. Harold Simmerman, program and papers committee chairman, reports that the lecture schedule is filled with the usual high quality technical papers covering a variety of topics. Plans are under way to provide not only an informative program but an entertaining one as well. (And remember the barbequed pig promised by Bob Walker?)

"PULLMAN POOL" IDEA CLICKS

The "Go Pullman to Winston-Salem" idea has picked up momentum and is spreading across the country like a summer heat wave.

It all started in Chicago during the 1947 convention. Someone suggested that Fellows from various sections of the country get together and charter Pullman cars to go to Winston-Salem in '48. The idea took hold and soon became a definite plan. In June, president Harold Fisher appointed sectional committees to make arrangements for chartering Pullman cars and to help the Fellows get together for a pleasant trip. We know smooth traveling to Winston-Salem is assured with the following Fellows heading up the area committees:

NEW ENGLAND, MIDDLE EAST AND ATLANTIC SEABOARD

Dr. William Walton, Chairman (Eastern Pennsylvania), 417 Anthwyn Road, Merion, Pennsylvania.

Dr. George Brown (New Jersey), 1311 Delaware Street, Paulsboro, New Jersey.
Dr. John Mogey (New York), Bank of Manhattan Building, New York, New York.
Dr. Leo Madigan, 59 Temple Place, Boston, Massachusetts.
Dr. Alton G. Billmeier (Maryland), Denton, Maryland.

NORTH CENTRAL, CENTRAL AND MIDWEST

Dr. Harry Pine, Chairman (Illinois), 8 South Michigan Boulevard, Chicago, Illinois.
Dr. Don B. Arden (Minnesota), Montevideo, Minnesota.
Dr. Ralph Wick (South Dakota), Woolworth Building, Rapid City, South Dakota.
Dr. G. H. Warkentine (Iowa), 634 Guaranty Building, Cedar Rapids, Iowa.
Dr. A. A. Schmidt (Cuyahoga), 708 Hippodrome Building, Cleveland, Ohio.
Dr. Herbert G. Mote (Central Ohio), 8 East Long Street, Columbus 15, Ohio.
Dr. W. E. Dewey (Michigan), Security Bank Bldg., Battle Creek, Michigan.
Dr. W. L. Van Osdol (Indiana), 605 State Life Building, Indianapolis, Indiana.

Academy Fellows interested in getting aboard should contact any one of the above-named members. Tentative arrangements are for Pullman cars to start at a designated point and pick up Fellows along the way to Winston-Salem, the midwest cars starting at Minneapolis or Chicago, the east coast cars somewhere in New England, etc.

Committee members should be contacted no later than November 1, 1948, as it obviously will take time to complete arrangements with the railroads. Academy members will be contacted soon to determine whether or not they plan to join a "Pullman Pool."

Members from the West Coast are now considering similar arrangements for their trip to Winston-Salem.

HOTEL RESERVATIONS

Reservations for hotel rooms may now be made at the Hotel, according to Dr. John D. Perry, Jr., of Winston-Salem. Send the reservation request directly to the Hotel Robert E. Lee, Winston-Salem, North Carolina. The convention dates are December 4-7, 1948. Be sure to designate that you are attending the Academy convention.

CONTACT LENS CERTIFICATION

Contact lens specialists wishing to be certified by the American Academy of Optometry in December, 1948, at the annual convention may now file a formal application to take the necessary examination, according to Dr. John C. Neill, chairman, contact lens section.

Under the certification procedure set up by resolution at the Chicago annual meeting in 1947, optometrists wishing to become contact lens diplomates must (1) comply with certain minimum requirements set up by the Academy, (2) pass an examination given by an appointed examining board, and (3) file with Dr. Neill not less

than 20 records of successful completed contact lens cases, together with evidence of formal instruction, or its equivalent, in the application of contact lenses.

Applicants filing an application before December, 1948, who have not completed the prerequisite number of cases will be notified to appear for examination but the awarding of the certificate will be withheld pending completion of the required number of cases.

Complete details of the resolution passed by the Academy to certify contact lens specialists may be found in the February, 1948, issue of the AMERICAN JOURNAL OF OPTOMETRY, pages 95-99, or obtained from Dr. John C. Neill, 5128 North Broad Street, Philadelphia 41, Pennsylvania.

Applications should be sent directly to Dr. Neill. As a certain amount of correspondence and paper work is necessary after filing of the application, candidates are urged to contact Dr. Neill as soon as possible for instructions on necessary procedure for becoming an examination candidate.

CHAPTER ACTIVITIES

MARYLAND

Maryland members held a round table on visual training in May. The discussion took place during dinner at the Stafford Hotel, Baltimore.

EASTERN PENNSYLVANIA

Dr. Luther A. Garns, Philadelphia, was elected president for the coming year at the annual business meeting of the Eastern Pennsylvania Chapter. Officers elected to serve with Dr. Garns are Dr. John C. Neill, Philadelphia, vice-president; Dr. William G. Walton, Merion, secretary-treasurer. Drs. Lawrence Fitch, Philadelphia, Fred W. Sutor, and William O. Vivian (past president) were elected to the executive council.

CORRESPONDENCE

To the Editor:

Following my "Comment on the Treatment of Myopia" published in the May issue of the AMERICAN JOURNAL OF OPTOMETRY, I thought your readers might like to hear the sequel.

I re-examined the boy after one term at school, where he had been giving himself the "plus" treatment for half an hour daily with the cooperation of the school authorities.

The myopia was unchanged at —2.75D. The acuity was maintained at 9/18. I am inclined to think that the ciliaries will relax (thus causing a tendency to exophoria) to that point which just maintains fusion. Thus the two techniques employed in this case have a reciprocal value, since the building up of the fusion sense will strengthen that function. I do not think one can "improve" the condition beyond the ability of the ciliaries to relax much beyond the negative relative range.

ERIC BATEMAN*

BRIDGE HOUSE
LOOE, CORNWALL, ENGLAND

*Fellow, American Academy of Optometry. F.B.O.A. (Hons.).

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

A.O.A. ELECTS DR. O'SHEA, PRESIDENT

New president of the American Optometric Association is Dr. John B. O'Shea of Northampton, Massachusetts. Dr. O'Shea was elected at the fifty-first annual congress of the A.O.A. held in San Francisco in June.

Dr. Ernest H. Kiekenapp, Minneapolis, Minnesota, was re-elected secretary for the 27th consecutive year. Other national officers who will serve with Dr. O'Shea during the next year are Dr. J. Ottis White, Baton Rouge, Louisiana, first vice-president; Dr. James A. Wahl, Anna, Illinois, second vice-president; Dr. Joseph N. Babcock, Portsmouth, Ohio, third vice-president, and Dr. Sam Brown, Fostoria, Ohio, treasurer.

Retiring president Dr. E. J. Richardson, Hollywood, California, and Dr. Lee Wayne Brock, Greenville, South Carolina, were elected to the board of trustees.

Attendance at the A.O.A. convention reached an all-time high, according to A.O.A. officials. More than 1,100 members and nearly 1,500 non-members were on hand to take in the program of lectures and entertainment, they reported.

During the convention, the delegates boarded buses to the University of California where they unveiled a dedicatory plaque to the

new School of Optometry. The 25th anniversary of the school was commemorated at the same session.

Boston, Massachusetts was chosen by delegates as the 1949 convention city.

OPTOMETRISTS IN THE NEWS

Optometrists from coast to coast made news in optometric circles during recent weeks. Four optometric educators were appointed to the editorial board of the QUARTERLY REVIEW OF OPHTHALMOLOGY: *Dr. Clifford L. Treleaven* and *Dr. Robert E. Bannon* of Columbia University's Optometry Laboratory; *Dr. Glenn A. Fry*, School of Optometry, Ohio State University and *Dr. K. B. Stoddard*, School of Optometry, University of California.

Special recognition was given two of its members by the New Jersey Optometric Association in June—to *Dr. John R. Wittekind* of Morrisville, Pennsylvania, for his work as chairman of their occupational vision section, and to *Dr. E. C. Nurock*, Camden, New Jersey, for his contributions to the advancement of the profession of optometry during the last 20 years.

And *Dr. Earl H. Ridgeway*, Trenton, New Jersey, was elected to the board of directors of the Better Vision Institute at its recent annual meeting.

ANNOUNCEMENTS

SUMMER GRADUATE COURSES

The Los Angeles School of Optometry will conduct a graduate seminar in optometry August 2 to September 10, 1948. Optometrists wishing to enroll should contact the school at 909 West Jefferson Boulevard, Los Angeles 7, California.

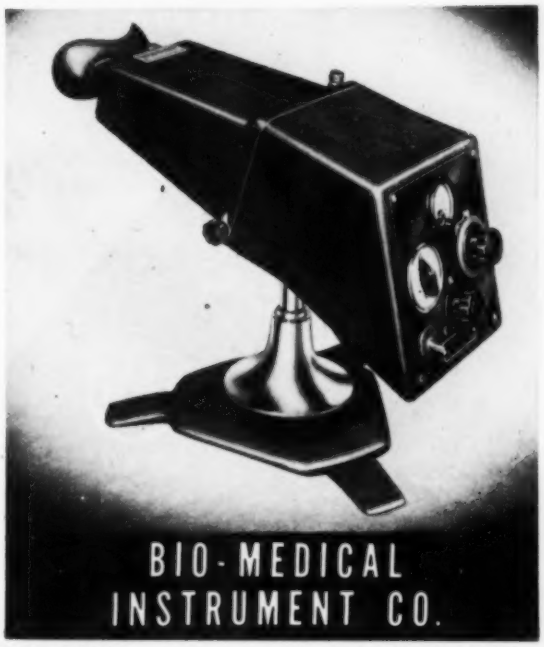
For the fourth consecutive year, the Pennsylvania State College of Optometry will offer a graduate course in the fitting of contact lenses. The session starts August 27, and will run through September 5, inclusively. Those interested in enrolling should write or wire the Registrar, 6100 North 12th Street, Philadelphia 41, Pennsylvania.

In Canada, a four-day refresher course in optometry, sponsored by the Saskatchewan Optometric Association, will open August 9 at the University of Saskatchewan. Further information on this course may be obtained from Harold C. Arnold, Registrar, Birks Building, Saskatoon, Saskatchewan, Canada.

the Bio-photometer.

*Simple to Operate * Accurate * Guaranteed*

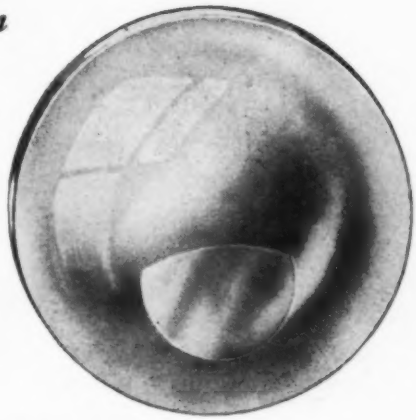
The Bio-photometer provides a fundamental visual test in connection with the ability of your patients to respond to light and darkness. Light thresholds are measured over an extremely wide range. A standard source of bright light is included so that a standardized test for dark adaptation can be made. You can detect even mild degrees of "night blindness" with the Bio-photometer. World-wide use since 1936. Fairly prompt deliveries for the first time in several years. Write for complete information.



Box 204A Chagrin Falls, Ohio

Precision made, infra-red absorptive Therminon now available in oval-top bifocals.

Therminon "A" Bifocals are of the same high quality that has made Therminon lenses so well known for providing eye comfort and protection.



WRITE FOR COMPLETE INFORMATION
"COOL FILTERED LIGHT IS BEST FOR SIGHT"

THERMINON LENS
CORPORATION

MANUFACTURERS OF THERMINON . . . AND OTHER FINE OPHTHALMIC LENSES

63rd & UNIVERSITY AVE. DES MOINES 11, IOWA

it's a Big Job they're doing for YOU!

It's a big job—and a never ending one—to teach 140 million people that *all eyes* need professional attention and care. To see the job through, these manufacturing members of the Better Vision Institute pledge their support. Thanks to their generosity and their business vision, the educational work of the Institute reaches and enlightens men, women and children in every walk of life, in every city, town and rural community in the U.S.

AMERICAN OPTICAL CO.

BAUSCH & LOMB OPTICAL CO.

BAY STATE OPTICAL CO.

SOFT-LITE LENS CO., INC.

THE KONO MFG. CO.

TITMUS OPTICAL CO., INC.

FRANK KREMENTZ CO.

THE UNIVIS LENS CO.

MARINE OPTICAL MFG. CO.

VICTORY OPTICAL MFG. CO.

SHURON OPTICAL CO., INC.

VIRGINIA LENS COMPANY, INC.

ZYLITE PRODUCTS CO.

These B.V.I. members are your allies. By backing the work of the Institute, they contribute to your professional standing and help build your patronage. Truly, these manufacturers merit your confidence and your encouragement. Stand by them as they stand by you! BETTER VISION INSTITUTE, Inc., 630 Fifth Avenue, New York 20, N. Y.

The Need for Education Never Ends

BVI

Mayfair
FUL-VUE

The Zyl frame (also available in blue) with optically correct lens areas and a bridge that really fits—combined with the popular upsweep.

Looks well on men, too.

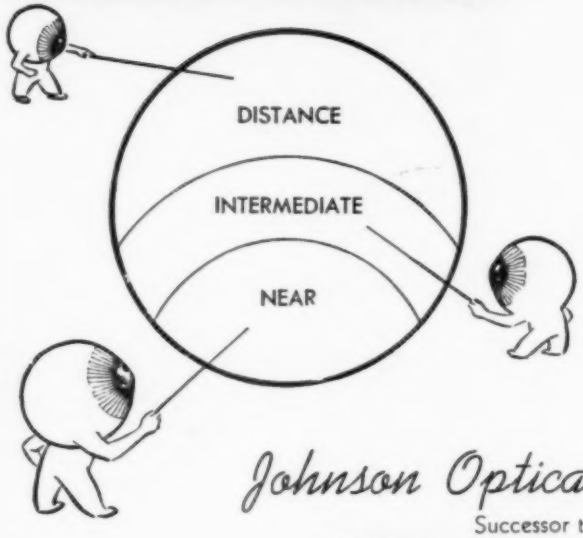
★ ★ ★

Minnesota Optical Company

621 West Lake Street - - Minneapolis

ULTEX trifocals
3-IN-ONEPIECE LENSES

☆ ☆ ☆ ☆ ☆



★ Trifocals restore seeing comfort and convenience to presbyopes whose powers of accommodation fall short of bridging the gap between their bifocals' near and distance fields.

Ultex Trifocals bring such patients all the advantages of other trifocals plus the one-piece advantages of lightness inside invisibility and freedom from color blur. Ultex Trifocals are available for immediate deliveries in clear and Kromatone tint—in seven combinations of intermediate and distance.

We suggest Ultex Trifocals for your patients and can assure speedy and accurate Rx service.

Johnson Optical Company

Successor to

JEFFERY OPTICAL COMPANY

301 Phy. and Surg. Bldg.
MINNEAPOLIS

Atlantic 2469

N. P. BENSON OPTICAL COMPANY

Established 1913

MAIN OFFICE & LABORATORY: MINNEAPOLIS, MINNESOTA

BRANCH LABORATORIES

Aberdeen : Albert Lea : Beloit : Bismarck : Brainerd : Duluth : Eau Claire : Huron
La Crosse : Miles City : New Ulm : Rapid City : Rochester : Stevens Point : Wausau : Winona

Announcement . . .

The 1948 Annual Meeting
of the
American Academy of Optometry

will be held at the

HOTEL ROBERT E. LEE

WINSTON-SALEM
NORTH CAROLINA

December 4, 5, 6 and 7,
1948

Room reservations accepted now.

HERING'S—
SPATIAL SENSE and
MOVEMENTS OF THE EYE

The only English translation, by Carl A. Radde, O.D., F.A.A.O.

An authoritative text presenting the fundamentals of binocular vision and ocular movements.

From the original German—a valuable addition to a library dealing with physiological optics. Prepared as an Academy project.

Bound in cloth . . . Mailed prepaid, $5.

AMERICAN ACADEMY OF OPTOMETRY

Foshay Tower Minneapolis 2, Minn.